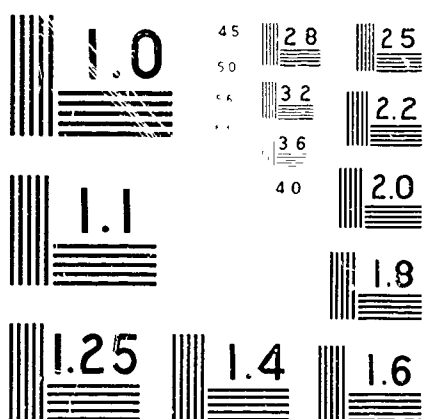


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A MODEL BUILDING CODE ARTICLE ON FALLOUT SHELTERS WITH  
RECOMMENDATIONS FOR INCLUSION OF REQUIREMENTS FOR FALLOUT  
SHELTER CONSTRUCTION IN FOUR NATIONAL MODEL BUILDING CODES.  
OFFICE OF CIVIL DEFENSE (DOD), WASHINGTON, D.C.

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DESCRIPTORS- \*FALLOUT SHELTERS, BUILDING DESIGN, SAFETY,  
STANDARDS,

A MODEL BUILDING CODE FOR FALLOUT SHELTERS WAS DRAWN UP  
FOR INCLUSION IN FOUR NATIONAL MODEL BUILDING CODES.  
DISCUSSION IS GIVEN OF FALLOUT SHELTERS WITH RESPECT TO-- (1)  
NUCLEAR RADIATION, (2) NATIONAL POLICIES, AND (3) COMMUNITY  
PLANNING. FALLOUT SHELTER REQUIREMENTS FOR SHIELDING, SPACE,  
VENTILATION, CONSTRUCTION, AND SERVICES SUCH AS ELECTRICAL  
POWER, SANITATION, WATER SUPPLY, AND STORAGE ARE LAID DOWN TO  
ESTABLISH OFFICIAL STANDARDS FOR THESE FACILITIES. (JT)

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# SUGGESTED BUILDING CODE PROVISIONS

for

# FALLOUT SHELTERS

report of a project  
sponsored by

DEPARTMENT OF DEFENSE



OFFICE OF CIVIL DEFENSE



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A MODEL BUILDING CODE ARTICLE ON FALLOUT SHELTERS WITH  
RECOMMENDATIONS FOR INCLUSION OF REQUIREMENTS FOR FALLOUT  
SHELTER CONSTRUCTION IN FOUR NATIONAL MODEL BUILDING CODES

a report of a project sponsored by

The Office of Civil Defense, United States Department of Defense

prepared by

Graves-Hill & Associates, Architects

200 North Upper Street

Lexington, Kentucky

under the auspices of

The American Institute of Architects

1735 New York Avenue NW

Washington, D.C. 20006

in accordance with the contract dated 30 June 1964 between

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7 October 1965

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## INTRODUCTION

Origin of Study. In 1961, the United States Department of Defense, Office of Civil Defense, initiated a survey to determine how much inherent fallout shelter space could be found in existing buildings throughout the Nation. A technique for determining protection factors had been developed and a computer program designed to eliminate the tedious calculations involved. Architectural and consulting engineering firms, retained to gather the data for this survey, completed the bulk of the investigations in 1962. As additional shelter was found in new buildings and places not covered in the original survey, it was added to the inventory. As of July 1965, 135,640,000 fallout shelter spaces had been located in existing buildings, fallout shelters with 77,219,000 spaces had been licensed for use as official public fallout shelters, and fallout shelters comprising 33,814,000 spaces had been stocked with supplies issued by the Office of Civil Defense.

Even though a large part of the population could be accommodated in fallout shelter space existing in older buildings, not all fallout shelters are located at the right places or with the right number of spaces. New fallout shelter space, meeting OCD minimum standards, is being created all the time. Although no Federal program to assist in the cost of developing fallout shelter space in new buildings (except to a limited degree in Federal buildings) now exists, this country could eventually have legislative incentives to encourage the building of fallout shelters in new buildings, particularly of the multi-use or dual-use variety. Dual-use refers to a normal-use space with the secondary function of shelter in time of emergency.

With this in mind, and recognizing that most building code ordinances in the United States do not now include regulations for fallout shelters, the Office of Civil Defense, in 1964, asked the American Institute of Architects to undertake a study of the incorporation of fallout shelter requirements into the four national model building codes: the International Conference of Building Officials Uniform Building Code, the Building Officials Conference of America Basic Building Code, the Southern Building Code Congress Standard Building Code, and the National Board of Fire Underwriters (now American Insurance Association) National Building Code.

An ad hoc committee was then appointed by the A.I.A and the Defense Department to review the need for incorporation of fallout shelter and to make recommendations. The following individuals served on the committee:

Mr. Ralph O. Mott AIA, Little Rock, Arkansas, Chairman,  
AIA Committee on Building Codes and Disaster Studies (BCDS)

Mr. William B. Tabler FAIA, New York City, Member, BCDS  
Committee

Mr. Victor C. Gilbertson AIA, Minneapolis, Minnesota,  
Member, BCDS Committee

Mr. Raymond Ziegler AIA, Los Angeles, California, Member  
BCDS Committee

Mr. Lyndon Welch AIA, Detroit, Michigan, Member, BCDS  
Committee

Mr. C. Henri Rush AIA, Executive Staff, Washington, D.C.

Mr. Robert Piper AIA, Executive Staff, Washington, D.C.

Mr. Robert Berne AIA, Washington, D.C., Chief Architect,  
Architectural and Engineering Services Division, OCD

Mr. James E. Roembke P.E., Washington, D.C., Director,  
Architectural and Engineering Services Division, OCD

Mr. W. W. Pritsky, New York City, Director of Codes and  
Standards, American Insurance Association (formerly National  
Board of Fire Underwriters)

Mr. Paul E. Baseler, Chicago, Illinois, Executive Director,  
Building Officials Conference of America

Mr. Albert P. Backhaus, Baltimore, Maryland, President, BOCA

Mr. T. H. Carter, Los Angeles, California, Managing Director  
of International Conference of Building Officials

Subsequently, the successor AIA Committee on Building Regulations continued in an advisory capacity to the project with Raymond Ziegler AIA serving as chairman and William B. Tabler FAIA, Lyndon Welch AIA, Murvan M. Maxwell AIA, Robert J. Brocker AIA, Earl P. Newberry AIA, and Roy M. Pooley Jr. AIA as members. Mr. George Bain Cummings FAIA, past president of AIA, served as chairman of the Committee on Building Codes and Disaster Studies during 1964.

The American Institute of Architects accepted the task of incorporating fallout shelter regulations into the model codes and, on 17 July 1964, entered into an agreement with Graves-Hill and Associates, Architects, Lexington, Kentucky, to perform the following services:

Scope of the contract: The agreement between Graves-Hill and the American Institute of Architects included the following to be executed by Graves-Hill:

1. Development of a permissive building code article based on OCD minimum technical requirements,
2. Development of administrative code provisions to permit relaxation of normal requirements during times of national emergency while retaining all code requirements for normal daily use,

3. A detailed study of the four national model codes to determine areas inhibiting inclusion of fallout shelter in buildings as dual-use space with specific recommendations for changes,
4. A detailed study of the four national model codes to determine where fallout shelter should be mentioned and to recommend material for insertion,
5. A survey to determine what has been done in other countries in the way of adopting ordinances to require the inclusion of fallout shelter in buildings, and
6. Submission of recommendations as to whether provisions for mandatory fallout shelter in new buildings should be initiated in this country and, if recommended, how best to accomplish this.

Procedures followed: The Building Regulations Committee of the American Institute of Architects was named as the Institute reviewing authority for the codes study project, and Mr. Robert Cowling AIA, Director of Technical Programs of the Institute was named staff coordinator. All of the work was performed by members of the Graves-Hill staff and consultants retained by them for the project. Mr. Cowling coordinated the Graves-Hill effort with activities of the Building Regulations Committee and kept the Committee members informed as to progress of the work. Beginning in February 1965, members of the Graves-Hill staff began meeting with representatives of the Building Regulations Committee at frequent intervals to review items of work completed. Mr. Robert Bocker AIA, Greensburg, Pennsylvania, acted for the Committee in a liaison capacity. Mr. Robert Berne AIA, Chief Architect, Architectural and Engineering Services Division, O.C.D., was the Project Officer for the Office of Civil Defense.

At various times during the progress of the work, Graves-Hill consulted with representatives of the Office of Civil Defense in Washington in order that their work might reflect, as nearly as possible, the thinking of the Defense Department.

Personnel: Persons assigned to or retained for this project by Graves-Hill, together with a brief resume of their qualifications, are as follows:

John W. Hill AIA: B.A., B.Arch. Rice University 1952, M.Arch. Pennsylvania University 1959. Partner, Graves-Hill and Associates, project director for codes-study project. Registered architect, NCARB and Kentucky. Qualified fallout shelter analyst and instructor, Dept. of Defense. Associate Prof. of Architecture, Univ. of Kentucky.

Charles P. Graves AIA: B.S., B.Arch. Georgia Tech. 1954, M.Arch. Pennsylvania 1957. Partner, Graves-Hill and Associates, Registered architect, Kentucky. Dean, School of Architecture, Univ. of Kentucky.



Clyde R. Carpenter: B.S. Kentucky 1959, B.Arch. Pennsylvania 1962. Associate Member of the East Kentucky Chapter of the American Institute of Architects, Graves-Hill and Associates. Instructor, School of Architecture, Univ. of Kentucky.

William L. Matthews, Jr.: A.B., LL.B., Kentucky. LL.M., S.J.D., Michigan, Legal Consultant to Graves-Hill for codes study project. Dean and Professor of Law, Univ. of Kentucky.

William H. Qualls AIA, AIP: B.S. in Arch., Virginia. MCP Georgia Tech. 1954. Planning Consultant to Graves-Hill for codes study project. Executive Director, City-County Planning Commission of Lexington, Kentucky.

James L. Leggett, CEC, KACE, ASCE, ASEE, NSPE: B.S. in C.E., M.S. in C.E., Kentucky. Ph.D. Purdue 1953. Structural Consultant to Graves-Hill for codes study project. Registered engineer, Kentucky. Partner, Leggett and Irvan Consulting Engineers, Lexington.

J. Virgil Proctor, CEC, NSPE: B.S.M.E. Kentucky, 1934. Registered Professional Engineer, Kentucky. Consultant to Graves-Hill for codes study project. Partner, Proctor-Ingels and Associates, Inc., Consulting Engineers.

Robert S. Moulton, SFPE, NFPA, ASA: Consulting Fire Protection Engineer, Weston, Massachusetts. Codes consultant to Graves-Hill for codes study project.

#### BACKGROUND DISCUSSION

Fallout: Nuclear weapons of both the "atomic bomb" and the thermonuclear or "hydrogen bomb" type utilize the principle of splitting the atoms of a heavy, unstable element such as uranium or plutonium. When an atom is split, or fissioned, two or more new smaller atoms, or "fission fragments" are formed with an accompanying release of energy from the nucleus. This energy represents the sole energy source in the "atomic bomb". This fission energy is used in the "hydrogen bomb" as a detonator to raise the temperature of one or more light elements, usually several forms, or isotopes, of hydrogen. At extremely high temperatures these light atoms can combine to produce heavier atoms. This is called "fusion". Fusion is also accompanied by a release of energy from the nucleus. In both the fission and fusion process the release of energy is translated into heat, light, blast and initial radiation. In addition, energy is released in both types of explosions in the form of radiation from the fission fragments. These fission fragments continue to release radiation energy until the unstable atoms reach a stable condition. The new elements formed in the fusion process do not release radiation.

Fission fragments are deposited on condensing bits of vaporized debris scoured up from the ground surface and from bomb material. These radioactive bits of matter, each made up in part of fission fragments, range in size between face powder and sand. They rise with the mushroom cloud, fall back to earth and are distributed over a very large area. The smaller particles often are carried to points

hundreds of miles downwind. Each particle, lying on the ground or on rooftops, continues to emit gamma radiation, which is hazardous to human life. With the passage of time, however, the radiation level reduces and becomes less dangerous.

Gamma rays are the most hazardous type of nuclear radiation. Like light, heat, or X-rays, gamma rays are a form of electromagnetic radiation. They are pure energy transmitted through space. Since they are electrically neutral, and have very high energies, they travel long distances before they interact with matter. When they do interact, they may be absorbed or merely deflected or scattered with a loss of energy. Gamma rays have the ability to ionize atoms of matter upon interaction. Ionization is the ability to remove electrons from their normal orbit around the nucleus of an atom. Human cells exposed to ionizing radiation may be damaged or they may be destroyed. Damage to a large number of cells may cause radiation sickness or death to the individual. Certain levels of radiation can be tolerated, however, and most cell damage can be repaired by normal regenerative processes.

Shielding: The function of shielding is to reduce the intensity of gamma radiation from fallout to a level which may be tolerated by human beings. Shielding may be accomplished two ways: by the interposition of mass, between the fallout particles and the people, sufficient to scatter or absorb the majority of the gamma rays or by removing the persons to be protected sufficiently far from the radiation sources to reduce the intensity of radiation. Shielding is nearly always accomplished by utilizing a combination of these barrier and distance factors.

Most gamma radiation from the fallout deposited on the ground comes directly to the walls of a building. Some ground radiation is deflected towards the building by atoms in the air. This is called "skyshine" and accounts for about 10% of the ground contribution. In addition to ground contribution, the contribution of gamma radiation from fallout on the roof must be considered. In typical above ground structures, approximately half the radiation comes from the roof and half from the ground.

A fallout shelter can protect its occupants by providing mass, in the forms of roofs, floors and walls, between the occupants and the fallout, and also by virtue of the distances from the roof and/or exterior walls to the occupants.

In planning shielding from radioactive fallout, it is impossible to guarantee complete protection. However, a relative protection level which reduces the gamma radiation penetration may be computed. The degree of protection depends on factors such as barrier thickness, building configuration, limits of the fallout field, etc. There is no way to exclude gamma radiation absolutely, but adequate shelter can reduce it to a level that can be tolerated by the human body.

Every enclosed space in a building provides some degree of protection. To increase the comfort of the occupants, spaces adjacent

So the fallout shelter itself might also be utilized as outdoor radiation intensity drops with the passage of time. The current Federal requirement for shielding in a public fallout shelter is a minimum protection factor of 40. This means that occupants of the shelter would receive only one-fortieth of the radiation they would receive in an unprotected position relative to the same fallout field. Protection factors are computed in accordance with a method for shelter analysis developed and promulgated by the Office of Civil Defense, Department of Defense. For several years architects and engineers have been qualified as Fallout Shelter Analysts through a series of graduate-level courses sponsored by the Office of Civil Defense across the Nation. Their names are listed in a national directory published by the Office of Civil Defense. Every public fallout shelter has been analyzed and certified by one of these qualified analysts before being so classified. All shelters in new buildings, to be designated and licensed as public fallout shelters, must also be certified by a qualified analyst.

National Policies: The Department of Defense evaluates potential enemy capability for launching a nuclear attack and assesses damage to the country from various types of attacks. By using mathematical gaming techniques, fallout patterns can be established for each of several types of attacks. No one can predict, however, which type of attack might be used or what climatic conditions affecting fallout might prevail at attack time. As a result, a policy has been established to consider a fallout protection factor of 40 as a minimum level of protection for the general public in public fallout shelters. OCD's goal is to make this protection available to everyone at all times. Fallout shelters are licensed by the Office of Civil Defense for public use in case of emergency. They are marked and stocked with survival supplies for two weeks' shelter stay time. This two-week figure is no magic number but is derived from potential fallout field characteristics and represents a reasonable protection time for the population during the period that fallout fission fragments are decaying radioactively. A rule of thumb for fallout decay characteristics is that for each sevenfold increase in time there is a tenfold reduction in gamma radiation intensity. For example, if radiation intensity levels at one hour after burst time were to be measured at 1000 roentgens per hour, seven hours later the intensity level would drop to about 100 r. per hour. These decay characteristics and potential levels of fallout gamma radiation indicate that a stay time of two weeks represents reasonable protection. In areas where fallout is light, this can be shortened.

Other nuclear weapons effects, including blast and shock, thermal radiation, and initial neutron and gamma radiation from the fireball are not considered in fallout shelter design. The limited range of these effects compared to the great range of potential lethal fallout fields has resulted in a national policy decision to strive to protect the entire population from the gamma radiation of fallout but not, at this juncture, to attempt to provide blast protection, except for military and other critical operational centers.



Various tests have shown that a lag time between weapon burst and arrival of fallout, outside the blast and thermal area, is significant although variable. About 15-30 minutes seems to be a minimum. In areas some distance from ground zero, the lag time could be hours. This is sufficient warning to permit most individuals to get to shelter, provided sufficient fallout shelters are available in the right places. National policy calls for each locality to develop an emergency plan for fallout shelter distribution and management. This work is presently under way augmented by the National Community Shelter Planning program of OCD.

The configurations and construction characteristics of most older buildings are such that many of them provide inherent fallout shelter in basements and intermediate floor core areas. As previously noted, by July 1965, 135,640,000 spaces had been located, 77,219,000 licensed for use and marked, and 33,814,000 stocked with supplies. Most of these are in buildings never designed for radiation protection.

Some additional factors which have been considered by the Department of Defense in national policy and by Graves-Hill in the development of the permissive code article presented in this report are listed below:

- (1) In all but a small part of the nation, blast damage will not be experienced and all local utilities will continue to function. However, in fallout areas, there will be a period when services such as maintenance services and fire and police protection will not be available due to high radiation levels.
- (2) Fallout shelters will be adequately supplied and marked, and will be managed by trained personnel who will have communications links to other fallout shelters and to operations centers. The governmental structure will function on a pre-planned emergency basis.
- (3) Greatest good for the greatest number, particularly the creation of a maximum number of well distributed fallout shelters, requires austere shelter space at minimum or no extra expense. It is better to give reasonable protection than none at all.
- (4) Water and air from outside the fallout shelter are not poisoned. Water may have to be passed through particulate filters to remove fallout particles, depending on various factors. The small quantity of radio-active isotopes from fallout which will dissolve and go into solution, as in the case of open reservoirs, may be neglected.
- (5) Any enclosed space affords some degree of protection from fallout gamma radiation. As radiation intensity levels decrease after the first few hours or days, fallout shelter occupants may be permitted to utilize other adjacent parts of the building affording lesser protection and may also venture outside for garbage and waste removal.
- (6) Area used for storage of shelter supplies need not have a protection factor of 40.

Fallout shelters: Current thinking, reflected in official policy in this country, is that the best fallout shelter, public or private, is that which is designed into a building as dual- or multi-use space. Routine use of the space assures that it will be maintained properly and will be immediately useful in case of emergency. It also provides maximum fallout shelter space per dollar invested. In many cases, protection can be achieved at no added expenditure simply by selecting materials for their inherent shielding ability and arranging building elements in a manner to increase shielding.

To be useful, fallout shelters must be available when needed. This implies appropriate location as well as appropriate normal use. Moreover, other supporting services must be available. The current Federal fallout shelter stocking program provides some of this support in the form of supplies comprising rations, water storage vessels, radiation detection instruments, medical kits, and sanitation kits. Storage of these supplies is considered in the proposed code articles.

Because the most austere criteria were applied when standards for fallout shelters were set, it must be realized that life in a fallout shelter probably will differ from normal, and that careful management of the fallout shelter in time of emergency will be required. Minimum space and ventilation requirements, delineated in the proposed building code articles may not be applicable everywhere. Particularly in hot weather, in some areas of the country, the effective temperature in a fallout shelter may rise to a point where discomfort will be experienced. This means that careful professional analysis of each fallout shelter design problem is required to determine whether minimum criteria are workable.

Two basic categories of fallout shelters were considered in writing the proposed building code article: dual-use and single-purpose. A dual-use fallout shelter is defined as one having a normal, routine function (primary) as well as having a fallout shelter function (secondary) in the event of emergency. In dual-use fallout shelters, it was felt that the basic code requirements for the normal use should apply, and that the only additional requirements for use of the space as fallout shelter should be those pertaining to radiation shielding, storage of supplies, and capacity. Other minimum requirements concerning exitways, etc., are set so low that in nearly every case the normal use requirements will govern. The single-purpose fallout shelter would very likely be a detached structure and, consequently, would have no building context in which to be designed. It was felt, therefore, that some minimum standards should be spelled out. For example, exit requirements and design live load requirements were set out specifically in the case of the single-purpose fallout shelter category.

The reasons behind the general exclusion of more stringent requirements above and beyond the OCD minima established by Technical Memorandum 61-3 (Rev. March 1965), Technical Requirements for Fallout Shelters, are as follows: (1) Adding more vigorous requirements, such as a rating of fire-resistive construction, above that required for normal use of the space would tend to slow the Federal



program of developing new fallout shelter space. (2) The fallout shelter itself as an individual, discrete building space cannot be assumed to guarantee survival of its inhabitants, due to many factors which are uncontrollable. (3) Statistically, a high degree of protection can be afforded the population as a whole if the minimum standard fallout shelter is available to everyone in an emergency.

In view of this consideration, it would seem to be an unnecessary expenditure of funds to create a very high degree of fire protection when protection against fallout radiation itself is only reasonably minimal. It is against fallout gamma radiation only that the fallout shelter is intended to form a protective shield. However, in accomplishing this, it will automatically give some degree of protection from other hazards.

It is of first importance to provide this minimum protection on a large scale. The decision to design the building code recommendations to parallel the Federal administrative requirements for licensed fallout shelters was taken in the spirit of lending maximum support to an essential and important national defense program: providing adequate minimal shelter against fallout radiation to every man, woman and child in the United States at any time or wherever he may be should an attack come.

#### THE WORKING HYPOTHESIS

Fallout shelters and administrative regulations: Generally speaking, building codes govern construction standards for buildings of various occupancy types. In most legal jurisdictions, other administrative regulations of the police department, fire department, board of health and other instrumentalities are promulgated under the general police power. These regulations generally have the force of law, but may be changed by administrative procedure. An example is the automotive vehicle speed limit, which may differ from one location in a town to another.

When occupancy or use of a building is contrary to the regulations contained in a building code ordinance, legal or administrative procedures designed to curb the abuse may be based on a violation of the building code ordinance or on violation of one or more of these administrative regulations. Inspection teams assigned these cases are often composed of members of the fire department, the building inspector's staff, and others.

The major function of a building code ordinance is to promulgate minimum safety standards by regulating design, quality of materials, types of construction, use, occupancy, location, and maintenance of buildings only where necessary. Modification of the building code ordinance alone, however, in any given political jurisdiction would be insufficient to guarantee the proper use and occupancy of fallout shelters. Other administrative regulations promulgated by city agencies should be carefully reviewed at the time of adoption of new code articles concerning fallout shelters. This will assure

consistent and appropriate integration of the new requirements in all regulations affecting the construction, use, or occupancy of space in buildings.

Fallout shelters and community planning: In order to make certain that a community does not gain the mistaken impression that a building code is the only local government control pertaining to fallout shelters, an explanation should be made as to the other pertinent controls and their relationships to a building code.

First, it should be mentioned that a building code is a tool used by a community to help guide its physical development by insuring that its buildings will incorporate provisions minimum for safety. In this same category are other local codes sometimes included in the building code, relating to the fire, electrical, sanitation, and plumbing safety of buildings. Any of these codes would undoubtedly contain provisions affecting fallout shelters.

All of these codes are intended to help a community achieve certain goals in relation to its physical development. These goals generally are expressed by certain community development plans. Chronological propriety dictates that plans should come first. Codes are later employed, along with other means, to carry out the proposals or goals of a community's plans.

It is generally agreed that four broad plans are necessary to guide a community's future growth: a land use plan, a transportation plan, a public utilities plan, and a public facilities plan. Although all four plans might have some relevance to fallout shelters, the public facilities plan is related most directly to fallout shelter planning.

A public facilities plan concerns itself with public needs for facilities such as fire stations, police stations, parks, and public fallout shelters. A public fallout shelter plan would determine the location of people and the buildings suitable for designation as public fallout shelters, and then propose means of assigning people to fallout shelters to insure that, in the event of a nuclear attack, each citizen would have a public fallout shelter space accessible to him within a distance he could reach in the time available. The plan also should propose means of providing public fallout shelters for future population growth and, if necessary, means to provide additional public fallout shelter spaces in the near future to accommodate any existing population which cannot be assigned to a public shelter space.

The community zoning ordinance is also of great importance. This means of implementing the plan by local law describes four things: (1) how each parcel of land in the community may be used (including use for fallout shelters), (2) the minimum lot size which must accompany any permitted use, (3) the amount of space within the lot that may be occupied by any physical structure, and (4) the height permitted for any such physical structure.

A zoning ordinance must first designate a fallout shelter as a permitted use before it can be constructed. Minimum standards

delineated in the building code for construction of fallout shelters must be met.

Any community desiring to provide comprehensive coverage for fallout shelters in relation to its overall development should, as a minimum, prepare a public fallout shelter plan and then propose means of carrying out the plan proposal through a zoning ordinance and a building code that include minimum standards for fallout shelter design, use, occupancy, location, and maintenance. In this connection, the office of Civil Defense has initiated the Community Shelter Plan (CSP) program designed to assist communities in their master planning to include shelter.

Basic requirements for fallout shelters: Any regulation of the construction of fallout shelters should meet at least the minimum criteria promulgated by the Office of Civil Defense, Department of Defense. Requirements more stringent than the official standards of the Federal government, in the development of its public fallout shelter program, would militate against early development of a viable fallout shelter program. Consequently, the recommendations proposed herein to be adopted by the national codes groups and integrated into their model codes are minimal and closely parallel Federal technical requirements. It is also considered essential that code adoption provide for frequent updating consistent with revisions to Federal Technical Requirements.

Fallout shelter requirements contained in various regulations promulgated by Federal, State, or local agencies should be closely consistent in both content and language if a national fallout shelter program is to remain viable and grow more sufficient to the need as time goes on. Quoted herein in its entirety is Technical Requirements for Fallout Shelters, Technical Memorandum 61-3 (revised March 1965), promulgated by the Office of Civil Defense.

Technical Memorandum 61-3  
(Revised) March 1965\*

TECHNICAL REQUIREMENTS FOR FALLOUT SHELTERS

I. General

The purpose of this technical memorandum is to establish official standards for fallout shelters.

II. Terminology

A. Protection Factor. A factor used to express the relation between the amount of fallout gamma radiation that would be received by an unprotected person and the amount that would be received by one in a shelter. For example, an occupant of a shelter with a PF of 40 would be exposed to a dose rate  $1/40$  (or 2-1/2%) of the rate to which he would be exposed if his location were unprotected.

B. Fallout Shelter. A structure, room or space that protects its occupants from fallout gamma radiation, with a protection factor of at least 40.

III. Radiation Shielding

A. Computation of protection factors shall be made by methods acceptable to the Office of Civil Defense.

B. In the calculation of the protection factor, the radiation dose contribution to the shelter occupants coming from the entranceways, ventilation ducts or other openings in the shelter's barriers shall be considered.

IV. Shielding Requirements

Detailed DoD studies of the lifesaving potential of fallout shelters indicate that for the current time-frame and for the foreseeable future, shelters with a protection factor of 40 could save over 90% of those persons who would otherwise die if unprotected against potential lethal radiation levels. Therefore, design and construction objectives are:

A. Shelters for the General Population. In modifications to existing buildings and in new construction, protection factors and shelter areas should be maximized to the extent possible, at nominal or no cost, using slanting techniques (See TM 64-2). Although minimum protection for a shelter area should be at least PF 40, the objective is to obtain the best protection factor possible. Computations indicate that decreasing returns in added lives saved per added dollar invested are obtained as PF's are increased significantly above 40. On a nationwide basis, therefore, it would provide better life-saving potential per dollar, for the same dollar expenditure, to obtain more shelter space of lower PF than only a few shelter spaces with very high PF.



B. Shelters for Emergency Operational Personnel. As it is anticipated that personnel with emergency functions may have to expose themselves to dangerous radiation levels during the performance of their duties, it is desirable to obtain the best possible protection factors for emergency operating centers or shelters housing emergency operational personnel, with an acceptable minimum objective of at least 100 PF.

C. Recognizing that in many design and construction projects it may be physically difficult or expensive to attain these minimum shielding objectives, it is still a worthwhile objective to increase protection factors to any level. Under many potential levels of radiation exposure, even these lower protection factors will save lives or minimize illness.

#### V. Space and Ventilation Requirements

A. Ten square feet of shelter floor area per person shall be provided.

B. At least 65 cubic feet of space per person shall be provided.

C. If the shelter capacity is based on minimum space requirements, then at least 3 cubic feet of fresh air per minute per person are required.

D. Shelter capacity or occupancy time may be limited by the volume of the room and not by its area. This is particularly true if mechanical ventilation is inadequate. When ventilation is limited, the following table can be used for determining the relation of space requirements to ventilation:

<u>Time for one complete air change (minutes)*</u>	<u>Volume of Space required per person (Cu. Ft.)</u>
1,000 or more -----	500
600 -----	450
400 -----	400
200 -----	300
100 -----	200
60 -----	150
35 -----	100
22 -----	65

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\* Computed as a ratio: 
$$\frac{\text{Net volume of space (cu. ft.)}}{\text{Fresh air supply (cfm)}}$$

E. No filters are required on mechanical ventilation systems other than those necessary for the normal daily use of the space.

F. In general, incremental costs of fixed ventilation equipment to meet shelter requirements shall not exceed \$2.50 per shelter space, the estimated cost of ventilating the shelter with packaged ventilation equipment approved by the Office of Civil Defense.



## VI. Construction Requirements

A. In general, conventional methods of design and construction for concrete, wood, steel, brick, structural tile and other products will be followed. Allowable stresses and/or load factors as defined in the applicable codes shall be used.

B. The structure shall be designed for a useful life of at least 10 years.

C. At least one unit of access and egress width should be provided for every 200 shelter occupants (a unit width is 22 inches, the space required for free travel of one aisle of persons). In no case shall a single passage width be less than 24 inches; nor shall there be less than two widely separated means of egress from each building. Emergency-type hatchways may be used as a means of egress. They shall be designed so that any normal-size adult can readily enter or leave the main shelter chamber.

D. In areas subject to high-ground water conditions, provisions shall be made to prevent flotation of underground shelters.

E. Provisions shall be made to insure the shelter interior will remain reasonably dry.

F. To the extent practicable, hazardous utility lines such as steam, gas, etc., should not be located in or near the shelter area unless provision is made to control such hazards before the shelter is occupied.

G. All shelters shall be constructed to minimize the danger of fire from both external and internal sources.

## VII. Services

A. Provisions shall be made for the storage of basic shelter supplies by allotting 1-1/2 cubic feet per person. This volume may be reduced to 0.6 cubic feet per person if the standard OCD 17-1/2 gallon water drums are not utilized. The live load attributable to placing these supplies should be considered. Fallout shelters with a capacity of 50 or more persons, which have been made available to the public should be stocked with:

1. Water - to provide each person with a minimum of 3-1/2 gallons of water.
2. Food - special crackers, biscuits, or wafers, etc., to provide 10,000 calories per person, deducting comparable food already available in the building.
3. Medical care kits.

4. Sanitation kits which include toilet tissue, sanitary napkins, toilet seat and commode chemicals. Empty water containers convert to commodes.

5. Radiation detection instruments.

B. Water Supply. An adequate supply of water from a suitable well, water trapped in the piping of the facility, or water storage tanks should be substituted, wherever feasible, for storage of drinking water in the standard OCD 17-1/2 gallon water drums.

C. Sanitation. Toilets may be provided on the basis of one per 50 occupants. In lieu of VII A 4 above, other austere provisions, based on economic considerations may be made for the disposal of garbage, trash, and human waste. Fifty percent of the toilets may be outside the shelter area, in other parts of the building, provided they are readily accessible without hazardous exposure to fallout gamma radiation.

D. Electrical power. It is assumed that normal electrical power will be available, therefore emergency generators are not required. No special lighting levels are required in fallout shelters. The following levels are deemed adequate for emergency occupancies:

1. Sleeping areas - 2-foot candles at floor level.
2. Activity areas - 5 foot candles at floor level.
3. Administrative and medical areas - 20 foot candles at desk level.

#### DISTRIBUTION:

##### OCD Regions

State and Territory CD Directors

Local CD Directors

OCD Schools

OCD Warning Centers

Defense Coordinators of Federal Agencies

Architects and Engineers Qualified in Fallout Shelter Analysis

Coordinators of Protective Structures Publications

Architectural and Engineering Firms  
Reviewing Protective Structures  
Publications

CE-BuDocks Field Offices  
(Engineers and Public Works  
Offices)

Technical Universities Interested  
in Nuclear Protective Construction

Architectural, Engineering and  
Consulting Firms w/Certified  
Fallout Shelter Analysts

\*Supersedes TM 61-3, August 1964.

Legal basis for the recommendations: Case and statutory law establish clearly that building codes are enacted as city ordinances under authority conferred on the municipality by the legislature to adopt and enforce laws pursuant to the state's police power. They must be reasonable and not arbitrary and must tend to promote the public health, safety, and welfare.

In a legal sense, building code standards may be classified as mandatory because a violation causes specific sanctions or remedies to be invoked to assure compliance. These may take the form of denial of permit, notice to vacate, suit for injunction, or a criminal penalty in the form of a fine. However, standards may be regarded as permissive in the sense that they do not obligate the owner to include spaces or facilities for particular uses in the building to be constructed, but rather, require compliance with building code standards of such spaces or facilities if actually constructed.

Fallout shelter standards as enacted by the proposed codes article are properly classified as permissive since they invoke no legal obligation on the building owner to construct or provide fallout shelter space. The proposed article does establish mandatory, enforceable standards, however, where the owner voluntarily undertakes to construct, designate, or use spaces for fallout shelter purposes. No separate or special penalty provision is made a part of the article, since a violation of it will bring into play the enforcement powers and procedures under the applicable code provisions generally. This approach will not lead to any special enforcement difficulties and is reinforced by a clear statement as to the purpose of the proposed permissive fallout shelter article.

The proposed article is designed especially to meet the obvious need for administrative relaxation of general building code provisions, making them inapplicable to fallout shelter spaces when occupied in time of national emergency.

This objective is achieved by a simple method of expressly confining the scope of the article (and its standards) to those spaces which are constructed, designated, and used for fallout shelter protection in a time of national emergency or reasonable periods of drill and instruction. During such times, the fallout shelter article standards apply exclusively. If the fallout shelter space is used for normal purposes at other times, the appropriate other sections of the code apply with respect to construction and occupancy.

This approach avoids the legal complications inherent in the use of separate provisions authorizing enforcement officials to relax certain code provisions in times of emergency. That alternative presents special problems in defining the circumstances and extent of administrative discretion to be exercised by the variously authorized and organized municipal enforcement offices of the nation.

Achievement of this objective by expressly confining and stating the scope of the shelter article clearly offers the best prospect

for legal and uniform administration of building code standards during a national emergency. Coupled with the affirmative statement that no provisions of the shelter article are intended to prohibit dual-occupancy use, this scope provision should encourage, and make legitimate, fallout shelter construction and designation. It also is consistent with the project purpose: to design a permissive article establishing minimum standards as measured by Office of Civil Defense minimum technical requirements.

#### A GENERALIZED PERMISSIVE BUILDING CODE ARTICLE

##### REGULATIONS GOVERNING FALLOUT SHELTERS

This article shall establish the minimum criteria which must be met before a building or building space can be constructed, occupied, used, or designated a fallout shelter.

Scope and applicability. The scope of this article extends to building spaces designated for use as fallout shelters including periods of drill and instruction for this purpose.

##### Definitions

Fallout shelter - A fallout shelter is any room, structure, or space designated as such and providing its occupants with protection at a minimum protection factor of forty (40) from gamma radiation from fallout from a nuclear explosion as determined by a Qualified Fallout Shelter Analyst certified by the Office of Civil Defense. Area used for storage of shelter supplies need not have a protection factor of 40.

Dual-use Fallout Shelter - A dual-use fallout shelter is a fallout shelter having a normal, routine use and occupancy as well as an emergency use as a fallout shelter.

Single Purpose Fallout Shelter - A single purpose fallout shelter is one having no use or occupancy except as a fallout shelter.

Protection Factor - A factor used to express the relation between the amount of fallout gamma radiation that would be received by an unprotected person and the amount that would be received by one in a shelter.

Unit of Egress Width - A unit of egress width is 22 inches.

General. Nothing in these regulations shall be construed as preventing the dual use or multiple use of normal occupancy space as fallout shelter space, providing



the minimum requirements for each use are met.

Mixed occupancy. The occupancy classification shall be determined by the normal use of the building. When a normal-use space is designed to have an emergency use as a fallout shelter in addition to the normal use, the most restrictive requirements for all such uses shall be met.

Occupancy separation. No requirements.

Space and ventilation. A minimum of ten (10) square feet of net floor area shall be provided per shelter occupant. Partitions, columns, and area for storage of Federal shelter supplies may also be included in net area. A minimum of sixty-five (65) cubic feet of volume shall be provided per shelter occupant. A minimum of three (3) cubic feet of fresh air per minute per person shall be provided.

Shelter capacity also shall be limited by the volume of the room or space. The following table shall be used to determine capacity of room or space in relation to available ventilation:

TIME FOR COMPLETE AIR CHANGE (MINUTES)*	VOLUME OF SPACE/PERSON (CU.FT.)
1000 or more	500
600	450
400	400
200	300
100	200
60	150
35	100
22	65

---

\*Computed as a ratio:  $\frac{\text{net volume of space (cu.ft.)}}{\text{Fresh air supply cfm.}}$

Windows. No requirements.

Illumination. No special lighting levels are required.

Exit facilities. There shall be no fewer than two widely spaced exits from a fallout shelter, leading directly to other spaces of the building or outdoors. Exits from the fallout shelter shall aggregate at least one unit of egress width for every 200 shelter



occupants. In no case shall a single exit be less than 24" wide.

Fire resistive construction requirements. No requirements.

Flame spread ratings of interior surfaces.

Div. I Dual-use fallout shelters. No requirement.

Div. II Single-purpose fallout shelters. Interior surfaces shall have a flame spread rating not exceeding 200.

Minimum design loads.

Div. I Dual-use fallout shelters. In the case of dual-use fallout shelters, design live load required for the normal use shall govern, except that concentrated loads shall be considered.

Div. II Single-purpose fallout shelters. Minimum live load for floor design in single-purpose fallout shelters shall be 40 lbs. per sq. ft. except that concentrated loads shall be considered.

Sanitation. Toilets, either flush type operating from the normal water supply system, or chemical or other types, shall be provided on the basis of one toilet per 50 fallout shelter occupants. Fifty per cent (50%) of the toilets may be provided outside the fallout shelter area. Empty water containers may be considered as fulfilling this requirement.

#### MANDATORY BUILDING CODE PROVISIONS FOR FALLOUT SHELTER

The broad question of whether mandatory fallout shelter provisions should be incorporated into municipal building codes has been considered in this study, with the conclusion that this approach should not be recommended or undertaken at this point.

The central issue here is a question of policy and might be resolved apart from the legal problems and implications which would appear to be involved. It is clear, however, that the legal context is one of the most important factors which should be taken into account in answering the basic policy question.

Only in a theoretical sense can municipal building codes be considered effective legal instruments for achieving compulsory construction of fallout shelter spaces in new buildings throughout the nation. In fact these codes at best are designed primarily to provide local statutory guide lines for the administrative control and regulation of building construction practices, especially where the owner proposes voluntarily to build a building to be used for particular purposes which involve the public safety and affect the public interest. For this reason they are not generally used to establish special public policy governing

the kinds of buildings and building spaces which must be created to assure public safety. However vital the need for this function of municipal government may be, the established pattern for meeting it in the other areas of the public welfare is to establish the policy by separate ordinance. In this way the standards can be tailored to the particular need and the legislation can be written to establish administrative and regulatory procedure applicable to such need. Protection for the residents of urban communities from radiation due to nuclear attack is essentially a unique problem, technically and in terms of the compulsory policy issue. The problem involved in making fallout shelter in new buildings mandatory might be solved best by special governmental legislation, whether expressive of national, state, or local policy.

It should be pointed out that this study has not disclosed any inherent legal limitations on use of building code provisions to achieve compulsory construction of fallout shelters at the local level. There is ample authority for the legal conclusion that a proper exercise of the police power may require the inclusion of particular facilities in particular kinds of buildings, or may require reasonable changes in buildings previously erected in order to comply with new requirements and standards for the protection of health and safety. It is clear also that the normal enforcement sanctions provided in a building code ordinance legally could be made applicable to a mandatory fallout shelter provision. Thus the authorizing permit could be granted or denied on this basis, the municipality could invoke injunctive remedies, and a criminal penalty or fine could be imposed.

The choice of approach as between the permissive provision and the "mandatory" or compulsory provision really runs to a matter of judgement in deciding which technique in a given time and set of circumstances offers the best prospect for nation-wide encouragement of fallout shelter construction according to desired minimum standards. If one examines rather critically the complex and diverse character of the municipal building code as a modern regulatory device, only its ready availability suggests that it ought to be used for the purpose stated above. As indicated in other parts of this study, this availability factor may justify the use of permissive code provisions in an effort to strengthen and legitimize the voluntary shelter program throughout the country. Availability does not offset other factors, however, in the case of compulsory fallout shelter provisions. These offsetting factors include: (1) the limited jurisdictional scope of municipal building code ordinances, (2) the task of careful and precise drafting essential to proper application of a compulsory standard, (3) the absence of a uniformly structured enforcement and administrative procedure, and (4) the degree to which proper enforcement of such a provision would depend on adequately trained technical personnel.

#### A SURVEY OF MANDATORY FALLOUT SHELTER REQUIREMENTS IN FOREIGN NATIONS

A survey of legislation enacted in foreign countries to require the provision of fallout shelter protection in new construction has been conducted by the Graves-Hill staff.

The survey encompassed information obtained from the Office of Civil Defense, the U.S. Army Library in Washington and the Library of Congress. The Graves-Hill staff searched these libraries for appropriate data. Promising titles listed in card catalogues were thoroughly investigated and, without exception, information discovered was either dated or unrelated. The most beneficial and pertinent information was obtained from the Office of Civil Defense.

This survey was based primarily on recent information from the Foreign Liaison Officer of the Office of Civil Defense and reports on Civil Defense in various European countries prepared by the Stanford Research Institute.

The survey indicated that many foreign countries, including Great Britain and France, have not adopted legislation or other regulatory measures to make the inclusion of fallout protection a mandatory part of new construction.

Some countries have enacted mandatory fallout shelter legislation. A recent study by the Office of Civil Defense revealed that West Germany, Belgium, Denmark, Finland, Norway, the Netherlands, Sweden and Switzerland have each undertaken means for achieving fallout shelter protection through legislation.

A Civil Emergency Planning Bill recently passed by the West German legislature concerns the construction of fallout shelters and requires the inclusion of fallout shelters in all new buildings, residential and industrial, with blast resistance of specified over-pressure required in densely populated areas. Federal subsidies are to be granted under the ordinance.

In Belgium, the central government has the authority under a civil defense act to designate the preparation of special fallout shelter locations in buildings. Building permits are issued in accordance with established rules.

In Denmark, legislation makes compulsory the inclusion of fallout shelters in new buildings having more than two dwellings which must provide both fallout and limited blast protection at the expense of the owners. All industries employing 75 or more persons at a single location are required to provide protective measures. Public fallout shelters have also been constructed by the government.

In Finland, a civil defense law requires the owners of all new buildings of a specified volume (3000 cubic meters or 105,930 cubic feet) within designated shelter areas and supervision districts to construct fallout shelter spaces. The central government must build shelters for personnel and transients at transportation terminals (railroad and air); local authorities provide fallout shelters in bus stations with reimbursement funds provided by the central government.

In Norway, legislation requires that municipalities construct public shelters, for which 2/3 of the cost is borne by the central government. Fallout shelters are required in all new buildings (apartments, churches, industries, hotels, theatres and residences) of a certain size at the expense of the owner in accordance with building regulations. Proposed legislation now under consideration would require the inclusion of specified degrees of blast protection in public and private shelters.

In the Netherlands, a decree stipulates that multi-family buildings must be provided with substructure fallout shelter for residents. Industries employing 30 or more persons must organize civil defense teams.

In Sweden, private fallout shelters of specified blast resistance are required in buildings in towns of 5000 or more with the exception of one-story, single-family buildings. Public fallout shelters must be provided in all new construction with the central government contributing 2/3 of the cost.

In Switzerland, fallout shelter provisions are required in communities of 1000 or more population for all new construction and remodeling of structures. For private fallout shelters, subsidies in the amount of 25-35% are allowed by the Federal government with a combined contribution by the commune and canton to meet a required 70% of total cost. For public fallout shelters, 40-50% of total cost is available as a subsidy by the government. The federal government will contribute 55-65% for shelter construction in hospitals.

In other foreign countries, sources consulted indicated either that no legislative or other regulatory measures had been enacted to provide fallout shelter protection in new construction or that no information pertinent to this survey was available.



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APPENDIX ARECOMMENDED CHANGES TO THE UNIFORM BUILDING CODE, 1964 EDITION (VOL. I)

The following changes are recommended to the International Conference of Building Officials for incorporation of fallout shelter requirements in the Uniform Building Code:

## Change No. 1

Pg. 43, Part III, Chapter 5, Sec. 503 (a) General  
add paragraph No. 3 under EXCEPTIONS:

3. Where a normal use space has a dual use as a fallout shelter, the normal uses of the space and building shall determine the occupancy classification and any requirements for separation, as specified in Section 503 (d).

## Change No. 2

Pg. 37, Sec. 409 (DEFINITIONS) Habitable Room:  
add after "utility rooms" the words "fallout shelters"

## Change No. 3

Pg. 42, Sec. 501, add after "J" the letter "K" and after the number 15 the number 15B

## Change No. 4

Pg. 48, Table No. 5-A, WALL AND OPENING PROTECTION OF OCCUPANCIES  
BASED ON LOCATION ON PROPERTY

Add:

GROUP	DESCRIPTION	FIRE ZONE	FIRE RESIST. OF EXT. WALLS	OPENINGS IN EXT. WALLS
K	fallout shelters		not regulated	not regulated

## Change No. 6

(this is not essential, but if Table No. 5-B, pg. 49, is to be made complete, another row at right end headed "K" and another category "K" at left bottom should be added, with the letter N printed under the K column to the right for each occupancy, because no separation is required for fallout shelters from any other space.)

## Change No. 7

Pg. 50, Table No. 5-C, Add "K" occupancy, unlimited allowable floor area.

## Change No. 9

Pg. 83, insert permissive article, appropriately sectioned and

numbered, as "Chapter 15B - Requirements for Fallout Shelters", as follows:

#### CHAPTER 15B - REQUIREMENTS FOR GROUP K OCCUPANCIES

This article shall establish the minimum criteria which must be met before a building or building space can be constructed, occupied, used, or designed as a fallout shelter.

Group K Sec. 1501B. Group K occupancies shall consist of fallout shelters.

**DEFINITIONS**      **Fallout shelter** - A fallout shelter is any room, structure, or space designated as such and providing its occupants with protection at a minimum protection factor of forty (40) from gamma radiation from fallout from a nuclear explosion as determined by an architect or engineer certified by the Office of Civil Defense as a Qualified Fallout Shelter Analyst.

**Dual-use Fallout Shelter** - A dual-use fallout shelter is a space having a normal, routine use and occupancy as well as having an emergency use as a fallout shelter.

**Single Purpose Fallout Shelter** - A single purpose fallout shelter is a space having no other use or occupancy than as a fallout shelter.

**Protection Factor** - A factor used to express the relation between the amount of fallout gamma radiation that would be received by an unprotected person and the amount that would be received by one in a shelter.

**Unit of Egress Width** - A unit of egress width is 22 inches, the space required for free travel of one file of persons.

**Div. I** - Dual-use fallout shelters.

#### OCCUPANCY GROUP SUBDIVISIONS

**Div. II** - Single purpose fallout shelter.

Nothing in these regulations shall be construed as preventing the dual use or multiple use of normal occupancy space as fallout shelter space, providing the minimum requirements for each such use are met.

#### SCOPE AND APPLICABILITY

Sec. 1502B

The scope of this chapter extends to a building or to a building space when it is being used as a fallout shelter in times of national emergency or for reasonable periods of drill and instruction. If the space is being so used, the provisions of this article shall apply, and if it is not

being so used, other applicable provisions of this code shall apply.

#### LOCATION ON PROPERTY

##### Sec. 1503B

Division I - Requirements determined by location on property for a building shall not be affected by inclusion of a fallout shelter.

Division II - For requirements determined by location on property for a single purpose, detached fallout shelter, see section 504 and Part V.

#### EXIT FACILITIES

##### Sec. 1504B

There shall be no fewer than two widely spaced exits from a fallout shelter, leading directly to other spaces of the building or outdoors. In no case shall a single exit be less than 24" wide. In addition, the following requirements shall be met:

Div. I - Dual-use Fallout Shelters. When requirements for normal occupancy of the space as detailed in SEC. 3302 of these regulations exceed the preceding they shall govern.

Div. II - Single-Purpose Fallout Shelters. In a single-purpose fallout shelter, exits from the fallout shelter shall aggregate at least one unit of egress width for every 200 shelter occupants or fraction thereof. Interior circulation within the fallout shelter shall be governed by requirements of Chapter 33 of these regulations.

#### SPACE AND VENTILATION

##### Sec. 1505B

A minimum of ten (10) square feet of net floor area shall be provided per fallout shelter occupant. Minor partitions, columns, and area for storage of Federal shelter supplies may be included in net area.

A minimum of sixty-five (65) cubic feet of volume shall be provided per fallout shelter occupant. A minimum of three (3) cubic feet of fresh air per minute per person shall be provided. Fallout shelter capacity or occupancy time may be limited by the volume of room and not by its area. The following table shall be used in determining the volume of space and ventilation required per person:



## TIME FOR COMPLETE AIR CHANGE (MINUTES)\* VOLUME OF SPACE/PERSON(CU.FT.)

1000 or more	500
600	450
400	400
200	300
100	200
60	150
35	100
22	65

---

\*Computed as a ratio: 
$$\frac{\text{net volume of space (cu.ft.)}}{\text{fresh air supply (cfm.)}}$$

## SANITATION Sec. 1506B

Toilets, either flush type operating from the normal water supply system or chemical or other types shall be provided on the basis of one toilet per 50 fallout shelter occupants. Fifty per cent (50%) of the toilets may be provided outside the fallout shelter area. Empty water containers may be considered as fulfilling this requirement.

## WINDOWS Sec. 1507B

No requirements.

## ILLUMINATION Sec. 1508B

No special lighting levels are required.

## Change No. 10

Pg. 103, Table No. 23-A - Unit Live Loads  
Add in alphabetical order:  
Fallout Shelters (see Chart 16)

Div. I . . . . . to be determined by normal occupancy requirements except that concentrated loads due to water storage shall be considered

Div. II . . . . . 40 (concentrated loads due to water storage shall be considered)

## Change No. 11

Pg. 311, Sec. 3302, par. 4, add after "For special requirements ...H"

delete word "and" and add "and Group K occupancies". Delete word "and" before "3320", add comma, and add "and 1504B."

#### Change No. 12

Pg. 312, end of Sec. 3302, add at end:

EXCEPTION: These requirements shall not be affected by inclusion of a dual-use fallout shelter (Div I Group K). Number of exits shall be as required by normal use occupancy.

#### Change No. 13

Pg. 313, Table No. 33-A, AVAILABLE SQUARE FEET PER OCCUPANT  
Add in alphabetical order:

USE	MINIMUM OF TWO EXITS REQUIRED ETC.	SQUARE FEET PER OCCUPANT
Fallout Shelters	(blank)	10

#### Change No. 14

Pg. 365, Table No. 42-B - MINIMUM INTERIOR FINISH CLASSIFICATIONS  
Add:

OCCUPANCY GROUP	ENCLOSED VERTICAL EXITWAYS	OTHER EXITWAYS	ROOMS OR AREAS
K	I	II	III

## APPENDIX B

### RECOMMENDED CHANGES TO THE BASIC BUILDING CODE, THIRD EDITION, 1960, WITH 1964 SUPPLEMENTS

The following changes are recommended to the Building Officials Conference of America for incorporation of fallout shelter requirements in the Basic Building Code:

Changes to the code required for incorporation of Permissive Building Code Article on Fallout Shelter

#### Change No. 1

Pg. 24 Article 2, Section 201.0 General Definitions:  
add in alphabetical order:  
    fallout shelter. (See section 430.2)

#### Change No. 2

Pg. 31 Section 202.0 Use Group Classification: delete word "and" before group M and add after "group M, miscellaneous buildings;" the words "and group N, fallout shelters."

#### Change No. 3

Pg. 36 Add new section 211.0-B  
Section 211.0-B Use Group N, Fallout Shelters  
All buildings and structures or parts thereof which are used for fallout shelters and so designated shall be classified in the fallout shelter use group.  
211.1-B - Use Group N-1 Fallout Shelters shall include all dual-use fallout shelters.  
211.2-B Use Group N-2 Fallout Shelters shall include all single-purpose fallout shelters

#### Change No. 4

Pg. 43 Table 6 - Height and Area Limitations  
N-2 Fallout Shelters (add symbol for unlimited ht. and size)

#### Change No. 5

Pg. 98 add new Section 430 as follows:  
Pg. 99 Section 430.0 FALLOUT SHELTERS  
This article shall establish the minimum criteria which must be met before a building or building space can be constructed, occupied, used, or designated as a fallout shelter,  
430.1 Scope and Applicability. -- The scope of this article extends to buildings or building spaces when they are being used as fallout shelters in times of national emergency or for reasonable periods of drill and instruction. If the

space is being so used, the provisions of this article shall apply, and if it is not being so used, other applicable provisions of this code shall apply.

#### 430.2 DEFINITIONS

**Fallout Shelters** - A fallout shelter is any room, structure, or space designated as such and providing its occupants with protection at a minimum protection factor of forty (40) from gamma radiation from fallout from a nuclear explosion as determined by an architect or engineer certified by the Office of Civil Defense as a Qualified Fallout Shelter Analyst.

**Dual-use Fallout Shelter** - A dual-use fallout shelter is a space having a normal, routine use and occupancy as well as having an emergency use as a fallout shelter.

**Single-Purpose Fallout Shelter** - A single-purpose fallout shelter is a space having no other use or occupancy than as a fallout shelter.

**Protection Factor** - a factor used to express the relation between the amount of fallout gamma radiation that would be received by one in a shelter.

**Unit of Egress Width** - A unit of egress width is 22 inches, the space required for free travel of one file of persons.

430.3 GENERAL. Nothing in these regulations shall be construed as preventing the dual use or multiple use of normal occupancy space as fallout shelter space, providing the minimum requirements for each such use are met.

430.4 EXIT FACILITIES. There shall be no fewer than two widely spaced exits from a fallout shelter, leading directly to other spaces of the building or outdoors. In no case shall a single exit be less than 24" wide. In addition, the following requirements shall be met:

430.41 USE GROUP N-1 (DUAL USE FALLOUT SHELTERS). When requirements for normal occupancy of the space as detailed in Article 6 exceed the preceding, they shall govern.

430.42 USE GROUP N-2 (SINGLE PURPOSE FALLOUT SHELTERS). Exits from the fallout shelter shall aggregate at least one unit of egress width for every 200 fallout shelter occupants or fraction thereof. Interior circulation within the fallout shelter shall be governed by requirements of Article 6 of these regulations.

430.5 SPACE AND VENTILATION. A minimum of ten (10) square feet of net floor area shall be provided per shelter occupant. Minor partitions, columns, and area for storage of



Federal shelter supplies may be included in net area. A minimum of three (3) cubic feet of fresh air per minute per person shall be provided.

A minimum of sixty-five (65) cubic feet of volume shall be provided per fallout shelter occupant.

Shelter capacity or occupancy time may be limited by the volume of the room and not by its area. The following table shall be used in determining volume of space and ventilation required per person:

TIME FOR COMPLETE AIR CHANGE VOLUME OF SPACE/PERSON (CU.FT.)  
(MINUTES)\*

1000 or more	500
600	450
400	400
200	300
100	200
60	150
35	100
22	65

---

\*Computed as a ratio:  $\frac{\text{net volume of space (cu.ft.)}}{\text{fresh air supply (cfm.)}}$

430.6 SANITATION. Toilets, either flush type operating from the normal water supply system or chemical or other types shall be provided on the basis of one toilet per 50 fallout shelter occupants. Fifty per cent (50%) of the toilets may be provided outside the fallout shelter area in other accessible parts of the building. Empty water containers may be considered as fulfilling this requirement.

430.7 WINDOWS. No requirements.

430.8 ILLUMINATION. No special lighting levels are required.

## Change No. 6

Pg. 99 Section 501.0 DEFINITIONS (light and ventilation)  
under "habitable room" add to list of spaces not included the  
words "and fallout shelters."

## Change No. 7

Pg. 99 Section 501.0  
add after paragraph on "occupiable room" the following:  
(Does not include fallout shelters. See Art. 4)

## Change No. 8

Pg. 101 Table 9-A Required Minimum Fresh Air Supply  
Add:

	<u>No. Air Changes/Hour</u>	<u>Cu. Ft./min./sq.ft.</u>
Fallout Shelters	See Article 4	-----

## Change No. 9

Pg. 115 Table 10 - Occupancy Allowances  
Add:

	<u>Floor area in sq. ft. per occupant</u>
Fallout Shelters	10

## Change No. 10

Pg. 134 Table 13 - Minimum Uniformly Distributed Live Loads  
add in alphabetical order:

## Fallout Shelters

Use group N-1 (dual use) . . . . . to be determined by normal  
occupancy requirements except  
that concentrated loads due to  
water storage shall be considered.

Use group N-2 (single purpose) . . 40 p.s.f. (concentrated loads  
due to water storage shall be  
considered)

## Change No. 11

Pg. 233 Add to Table 16B - Interior Finish Requirements

CLASS	USE GROUP	REQ'D VERTICAL EXITWAYS AND PASSAGEWAYS	CORRIDORS	ROOMS (ETC.)
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N-1 Dual-use Fallout Shelters - normal occupancy requirements but  
not less than requirements for Class N-2.

N-2	Single-Purpose Fallout Shelters	I	II	III
-----	---------------------------------------	---	----	-----

Change No. 12 Add to Appendix M:

Use Group N-1 - FALLOUT SHELTERS (dual-use)  
Use Group N-2 - FALLOUT SHELTERS (single-purpose)

	<u>Use Group N-1</u>	<u>Use Group N-2</u>
Location and Exposure	Table 5. Depends on normal use	Table 5
Height and Area	Table 6. Depends on normal use	Not regulated
Special Requirements, Fallout Shielding	430.2	430.2
Mixed or Dual Occupancy	Two or more uses, 213.1 Incidental use 213.2	
Fire Grading	Normal use governs	No special requirements
Flame Spread Rating of Interior Surfaces	See Table 16B, Section 922.1	
Stairs and Exits	Normal use governing: Article 6	Means of egress: 430.4 Internal circulation: Art. 6
Light & Ventilation, Space Requirements, Sanitation	Normal use governs if requirements exceed those of Section 430.0	See Section 430.0

APPENDIX CRECOMMENDED CHANGES TO THE SOUTHERN STANDARD BUILDING CODE, 1965 EDITION

The following changes are recommended to the Southern Building Code Congress for incorporation of fallout shelter requirements in the Southern Standard Building Code:

Changes to the code required for incorporation of permissive building code article on fallout shelter

## Change No. 1

Page 3, Chapter 2, Section 201.2  
Add in alphabetical order:  
Fallout shelter. (see Section 515.2)

## Change No. 2

Page 4, Chapter 2, Section 201.2  
Habitable room: add after "cellars" the words "fallout shelters"

## Change No. 3

Page 1, Chapter 4, Section 401.1  
Occupancy groups:  
Add after group H "Group I - Fallout Shelters"

## Change No. 4

Page 25, Chapter 4,  
Add new Section 413  
"SECTION 413.0 - Group I - Fallout Shelters"  
"All buildings and structures or parts thereof which are used for fallout shelters and so designated shall be classified in the fallout shelter use group."  
  
"413.1 Group I-I, fallout shelters shall include all dual-use shelters.  
  
"413.2 Group 1-2 Fallout shelters shall include all single-purpose fallout shelters."

## Change No. 7

Page 24, Chapter 4, Section 412.5  
Under table of minimum requirements, add (in order)  
Group I-2 - Single Purpose Fallout Shelters      No requirements for  
fire-resistive separation



Change No. 8

Page 20, Chapter 5, add new section 515 as follows:

## SECTION 515 - FALLOUT SHELTERS

This article shall establish the minimum criteria which must be met before a building space can be constructed, occupied, used or designated as a fallout shelter.

### 515.1 SCOPE AND APPLICABILITY

The scope of this section extends to a building or to a building space when it is being used as a fallout shelter in time of national emergency or for reasonable periods of drill and instruction. If the space is being used as a shelter, the provisions of this article shall apply, and if it is not being so used, other applicable provisions of this code shall apply.

### 515.2 DEFINITIONS

Fallout Shelter - A fallout shelter is any room, structure or space designated as such and providing its occupants with protection at a minimum protection factor of forty (40) from gamma radiation from fallout from a nuclear explosion as determined by an architect or engineer certified by the Office of Civil Defense as a Qualified Fallout Shelter Analyst.

Dual-use Fallout Shelter - A dual-use fallout shelter is a space having a normal, routine use and occupancy as well as having an emergency use as a fallout shelter.

Single-Purpose Fallout Shelter - A single-purpose fallout shelter is a space having no other use or occupancy than as a fallout shelter.

Protection Factor. A factor used to express the relation between the amount of fallout gamma radiation that would be received by an unprotected person and the amount that would be received by one in a shelter.

Unit of Egress Width - A unit of egress width is 22 inches, the space required for free travel of one file of persons.

### 515.3 GENERAL

Nothing in these regulations shall be construed as preventing the dual use or multiple use of normal occupancy space as fallout shelter space, providing the minimum requirements for each such use are met.

### 515.4 EXIT FACILITIES

There shall be no fewer than two widely spaced exits from a fallout shelter, leading directly to other spaces of the building

or outdoors. In no case shall a single exit be less than 24" wide. In addition, the following requirements must be met:

#### 515.41 GROUP I-1 (dual-use fallout shelters)

When requirements for normal occupancy of the space as detailed in Chapter II exceed the preceding the normal occupancy requirements shall govern.

#### 515.42 GROUP I-2 (Single Purpose Fallout Shelters)

Exits from the fallout shelter shall aggregate at least one unit of egress width for every 200 shelter occupants or fraction thereof. Interior circulation within the fallout shelter shall be governed by requirements of Chapter II of these regulations.

### 515.5 SPACE AND VENTILATION

A minimum of ten (10) square feet of net floor area shall be provided per fallout shelter occupant. Minor partitions, columns, and area for storage of Federal shelter supplies may be included in net area. A minimum of sixty-five (65) cubic feet of volume shall be provided per fallout shelter occupant. A minimum of three (3) cubic feet of fresh air per minute per person shall be provided.

Fallout shelter capacity or occupancy time may be limited by the volume of room and not by its net area. The following table shall be used in determining volume of space required per person:

TIME FOR COMPLETE AIR CHANGE (MINUTES)*	VOLUME OF SPACE/PERSON (CU.FT.)
1000 or more	500
600	450
400	400
200	300
100	200
60	150
35	100
22	65

\*Computed as a ratio:

net volume of space (cu.ft.)  
fresh air supply (cfm.)

515.6 WINDOWS

No requirements.

515.7 ILLUMINATION

No special lighting levels are required.

515.8 SANITATION

Toilets, either flush type operating from the normal water supply system or chemical or other types shall be provided on the basis of one toilet per 50 fallout shelter occupants. Fifty per cent (50%) of the toilets may be provided outside the fallout shelter area. Empty water containers may be considered as fulfilling this requirement.

## Change No. 9

Page 4, Chapter 7, Section 702.2

Add after group H the following:

"Group I - Fallout shelters - Fire-resistive partitions in fallout shelters are not required.

## Change No. 10

Page 2, Chapter II, Section 1103.1

Table of maximum distance of travel to an exit

Add:

Group I, Fallout Shelters (single-purpose) . . . . . 150

## Change No. 11

Page 4, Chapter 11, Section 1105.1

Table of occupancy allowances

Add:

Group I - Fallout Shelters 10 sq. ft.

## Change No. 12

Page 5, Chapter 11, Section 1106 (a)

Add at end of first sentence after "fire-resistance":

"; except that such stairways, platforms, landings, and hallways may be enclosed with partitions of not less than one-hour fire-resistance in buildings occupied by more than forty (40) people above or below the story at street level when such occupancy is in connection with use of a designated portion of the building as a fallout shelter in times of emergency."

Change No. 13

Page 1, Chapter 12, Section 1203.1 (a)

Table of minimum live loads

Add in alphabetical order:

Fallout Shelters - Group 1-1 (dual-use) . . . to be determined by normal occupancy requirements except that concentrated loads due to water storage shall be considered.

Fallout Shelters - Group 1-2 (single-purpose). . 40 p.s.f. (concentrated loads due to water storage shall be considered)

Change No. 14

Chapter 20, Page 2, Section 2001.6

Add new paragraph as follows:

" (c) For ventilation requirements of fallout shelters, see Section 515.5."



APPENDIX DRECOMMENDED CHANGES TO THE NATIONAL BUILDING CODE, 1955 EDITION AS  
AMENDED DECEMBER 1957 & JANUARY 1963

The following changes are recommended to the American Insurance Association (successor to National Board of Fire Underwriters) for incorporation of fallout shelter requirements in the National Building Code:

## Change No. 1

Page 15, Section 200, DEFINITIONS, add in alphabetical order:  
Fallout shelter - see section 323.2 of these regulations

## Change No. 2

Page 16, Section 200, DEFINITIONS, change definition of "Habitable room" as follows: delete word "or" before "communicating corridors," add to end of sentence: "or fallout shelters."

## Change No. 3

Page 23, Section 300.1  
add after 300.1 (i):  
(j) Fallout Shelter means any room, structure, or space designated, used, or occupied as such and meeting the criteria of the definition of fallout shelter, SECTION 323.2 of these regulations.

## Change No. 4

Page 23, Section 310, add after "Places of Assembly (etc.):"  
Fallout Shelters (section 323)

## Change No. 5

Page 37, add new Section 323 as follows:

## Section 323. FALLOUT SHELTERS

This article shall establish the minimum criteria which must be met before a building or building space can be constructed, used, or designated a fallout shelter.

323.1 Scope and applicability

The scope of this article extends to building spaces when they are being used as fallout shelters or for reasonable periods of drill and instruction. If the space is being so used, the provisions of this article shall apply, and if it is not being so used, other applicable provisions of this code shall apply.

### 323.2 Definitions

Fallout shelter - A fallout shelter is any room, structure, or space designated as such and providing its occupants with protection at a minimum protection factor of forty (40) from gamma radiation from fallout from a nuclear explosion as determined by an architect or engineer certified by the Office of Civil Defense as a Qualified Fallout Shelter Analyst.

Dual-use Fallout Shelter - A dual-use fallout shelter is a space having a normal, routine use and occupancy as well as having an emergency use as a fallout shelter.

Single-Purpose Fallout Shelter - A single-purpose fallout shelter is a space having no other use or occupancy than as a fallout shelter.

Protection Factor - A factor used to express the relation between the amount of fallout gamma radiation that would be received by an unprotected person and the amount that would be received by one in a shelter.

Unit of Egress Width - A unit of egress width is 22 inches, the space required for free travel of one file of persons.

### 323.3 Occupancy group subdivision

Div. I - Dual-use fallout shelters

Div. II - Single-Purpose fallout shelters

Nothing in these regulations shall be construed as preventing the dual or multiple use of normal occupancy space as fallout shelter space, providing the minimum requirements for each such use are met.

### 323.4 Exit facilities

There shall be no fewer than two widely spaced exits from a fallout shelter, leading directly to other spaces of the building or outdoors. In no case shall a single exit be less than 24" wide. In addition, the following requirements shall be met:

Div. I Dual-use Fallout Shelters. When requirements for normal occupancy of the space as detailed in Article VI of the regulations exceed the preceding they shall govern.

Div. II Single-Purpose Fallout Shelters. In a single-purpose fallout shelter, exits from the fallout shelter shall be provided as required in Sections 608 and 609 of these regulations.

### 323.5 Space and Ventilation

A minimum of ten (10) square feet of net floor area shall be provided per fallout shelter occupant. Minor partitions, columns, and area

for storage of Federal shelter supplies may also be included in net area. A minimum of sixty-five (65) cubic feet of volume shall be provided per fallout shelter occupant. A minimum of three (3) cubic feet per minute per person shall be provided.

Fallout shelter capacity or occupancy time may be limited by the volume of room and not by its area. The following table shall be used in determining the volume of space required per person:

TIME FOR COMPLETE AIR CHANGE (MINUTES)\* VOLUME OF SPACE/PERSON (CU.FT.)

1000 or more	500
600	450
400	400
200	300
100	200
60	150
35	100
22	65

\*Computed as a ratio:

$$\frac{\text{net volume of space (cu.ft.)}}{\text{fresh air supply (cfm.)}}$$

### 323.6 Sanitation

Toilets, either flush type operating from the normal water supply system or chemical or other types shall be provided on the basis of one toilet per 50 fallout shelter occupants. Fifty per cent (50%) of the toilets may be provided outside the fallout shelter area. Empty water containers may be considered as fulfilling this requirement.

### 323.7 Windows

No requirements.

### 323.8 Illumination

No special lighting levels are required.

### Change No. 6

Page 64, Section 608(b) HALLWAYS, add to end of table under number of occupants per unit of hallway or passageway width:

Single-purpose fallout shelters . . . . . 200

## Change No. 7

Page 65, Section 609(b) (Doorway) width, add to end of table  
under number of occupants per unit of door opening width:  
Single-purpose fallout shelters . . . . . 200

## Change No. 8

Page 106, Section 902.1 Floor loads, add in alphabetical order:  
Fallout Shelters:  
Dual-use . . . . . as required by normal use except that concentrated  
loads due to water storage shall be considered.  
Single purpose . . 40 p.s.f. (concentrated loads due to water storage  
shall be considered)