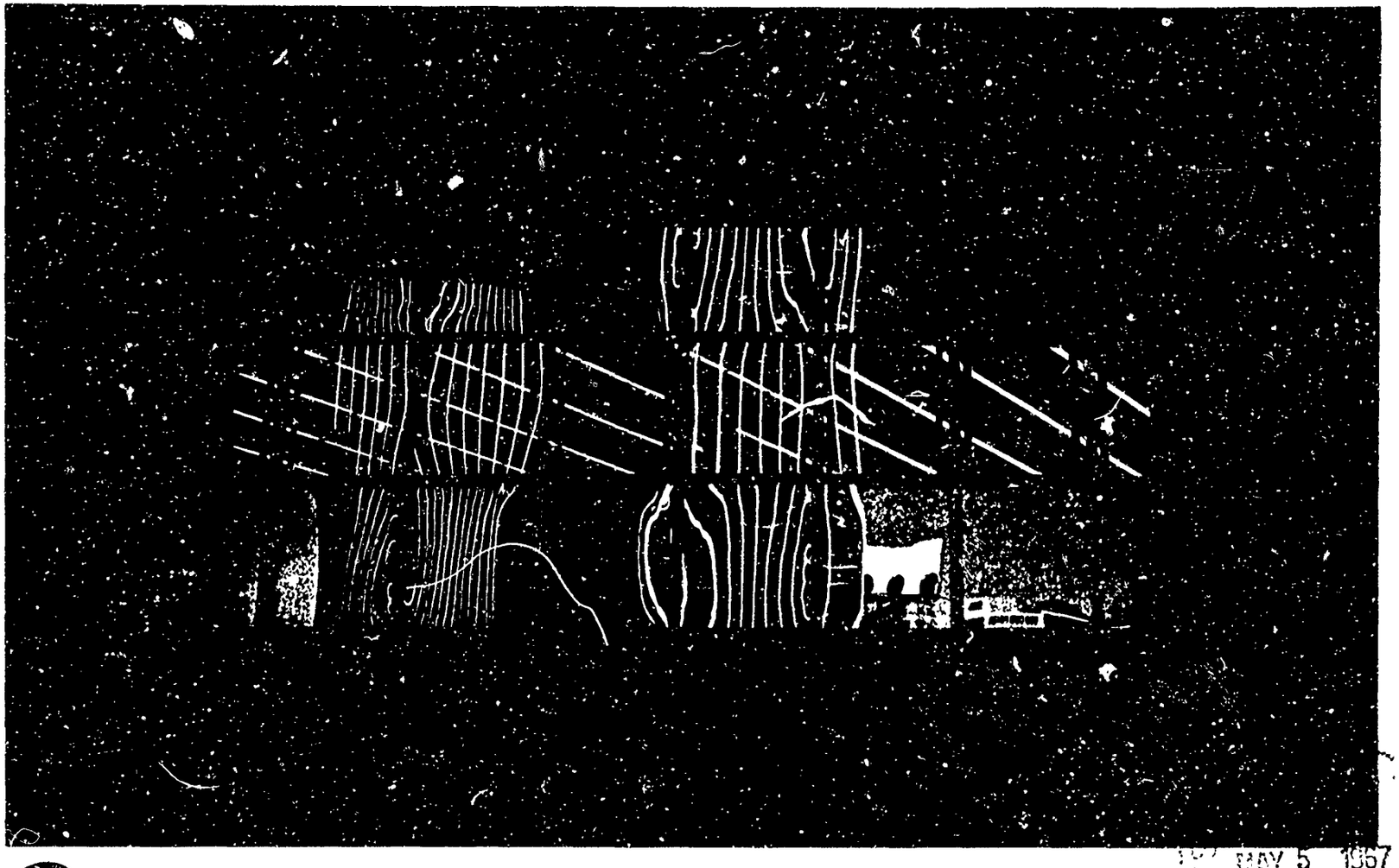
BUILDINGS WITH FALLOUT SHELTER

AD651182



Department of Defense / Office of Civil Defense / TR-37 July 1966

ARCHIVE COPY

MAY 5 1967

A

INTRODUCTION

Civil Defense is an integral part of the defense posture of the United States. Attack with nuclear weapons, however unlikely, threatens the greatest damage to the nation. While the likelihood of attack is small, the threat is large and present. More and more nations have or will have the capabilities of manufacturing and delivering nuclear weapons.

The current program is based on protection against fallout by identifying and preparing for use those areas of buildings which would provide adequate shielding from lethal radiation. Millions of shelter spaces have already been located in existing buildings. Additional shelter space is added to the national inventory each year in new construction projects. This rate, however, is not nearly enough to meet requirements. Additional shelter spaces are still needed to provide protection for every American.

The buildings depicted in this booklet illustrate what is now being accomplished to help overcome the deficit of shelter spaces. These are actual buildings that have recently been completed or are now under construction; they are not hypothetical designs.

This booklet contains descriptions, photographs, drawings and cost analyses of various types of new buildings with built-in fallout protection. Architects and engineers knowledgeable in shielding techniques can incorporate the additional fallout protection for little, if any, increase in cost, whether the building is a school, bank, library, church, dormitory, office building, industrial facility or home for the aged. The shielding techniques are applicable to all types of buildings. The projects shown here are attractive and contain fallout shelter in aboveground as well as belowground locations. The shelter areas are in continuous use as part of the normal building function and have been provided without adversely affecting the cost or appearance.

BASIC CONCEPTS OF PROTECTION

When a nuclear explosion occurs at ground level, it produces widespread fallout of radioactive debris. This fallout will begin to deposit near the detonation, usually within 15 minutes after the burst. Fallout will continue to settle on the ground, trees, rooftops, etc., for approximately 12 to 24 hours. The debris usually falls in an irregular pattern, dictated by wind direction, and often covers hundreds or thousands of square miles. The heavier fallout particles settle out first; the lighter fallout particles settle out much later and farther away. These lighter particles continue to settle for a longer period, but their potency diminishes with time. Protection from fallout gamma radiation is the primary objective of the National Fallout Shelter Program.

The gamma rays emanating from fallout particles could cause sickness or death to millions of unprotected persons. Since fallout gamma radiation decays rapidly with time, it is possible for persons who have taken shelter to emerge when the radiation intensity has declined to a tolerable level.

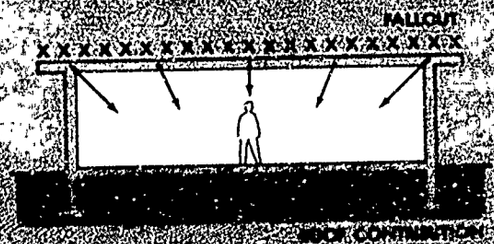
Gamma radiation reaches an individual in an enclosure from several sources: The roof contribution refers to radiation from fallout deposited on the roof; the ground contribution refers to all similar radiation originating from fallout particles on the ground. The ground contribution is further subdivided into ground direct, wall scatter and skyshine components.

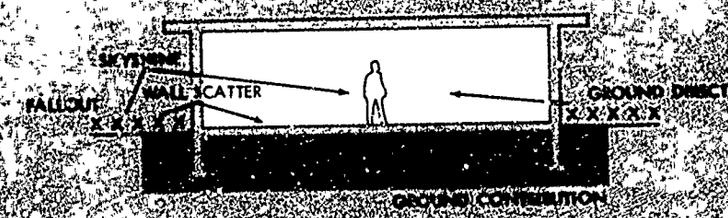
Fallout protection is obtained through use of two basic shielding approaches--barrier shielding and geometry shielding. Barrier shielding places a mass between the radioactive source and the shelter occupant. This mass attenuates or reduces the amount of radiation which passes through. Any normal construction material can be used; however, the heavier materials such as concrete and brick provide a better shield than the lighter materials such as wood or glass. Geometry shielding places people out of the direct path of radiation or at some distance from it. Placement of the shelter in a basement location is an example of geometry shielding since the ground direct radiation is no longer contributing to the total radiation dose. The effect of gamma radiation is also lessened as the distance from the source is increased, much the same as light intensity lessens the further one is from the source.

Protection Factor (PF) expresses the relation between the amounts of radiation that would be received by an unprotected person and a person inside the shelter. Thus an unprotected person would receive 40 times more radiation than a person inside a shelter with a PF of 40.

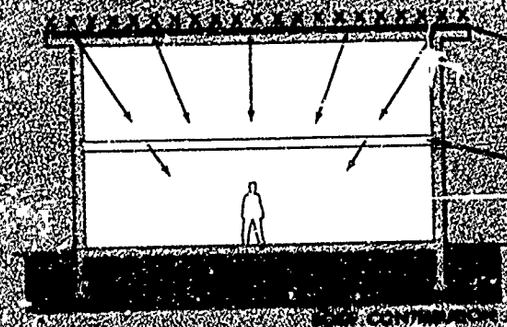
Shelters with high protection factors are achieved by the planning and control of geometric and barrier relationships between the radioactive source and the sheltered enclosure.

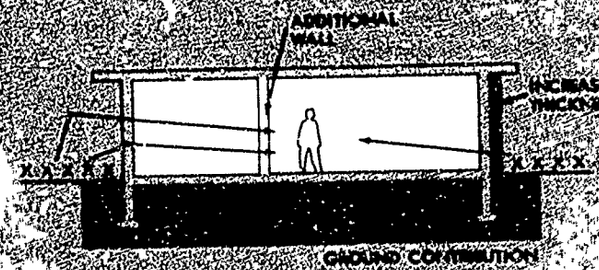
BARRIER SHIELDING



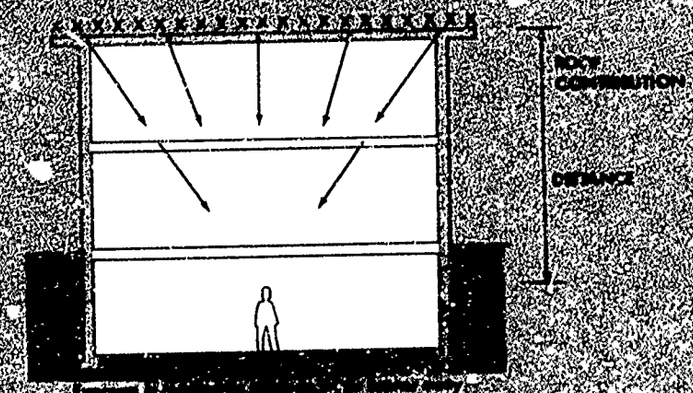


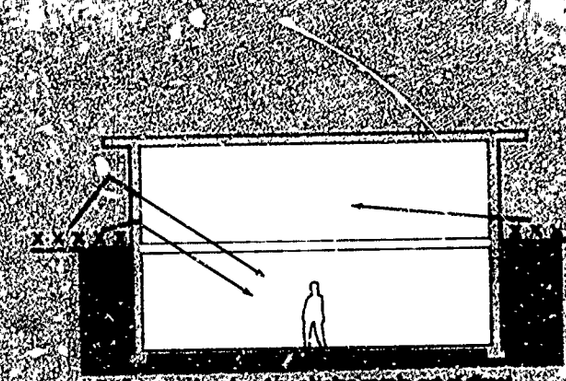
Radiation attenuation can be improved by providing additional horizontal and vertical barriers or by increasing the density of the existing barriers.





GEOMETRIC SHIELDING





Exposure is reduced by placing people out of direct path of radiation.

Esther and Philip Klein Hall Dormitory
Harcum Junior College

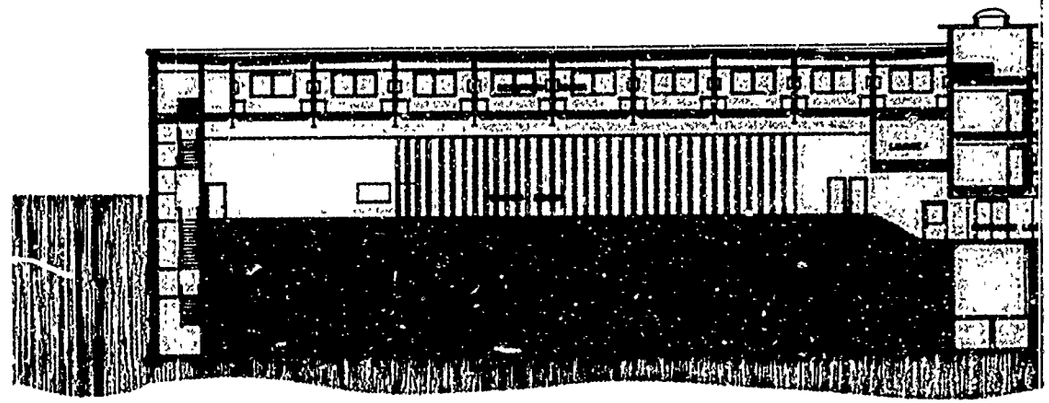
Bryn Mawr, Pennsylvania
Beryl Price, FAIA, Architect
Philadelphia, Pennsylvania

The Klein Hall dormitory building at Harcum Junior College is a three-story split-level brick building. Rectangular in plan, the building is split so that there are one-half level separations between floors at the north and south ends.

The building is essentially a dormitory for 110 residents but contains a large dining room and cafeteria area on the first floor. These dining facilities serve not only the building residents but 400 additional students from other buildings on campus. A gymnasium and locker room area that also serves as a fallout shelter is located in the basement.

The College directed the architect to incorporate fallout protection in the design of the dormitory. This was accomplished by placing the gymnasium in the basement, for esthetic purposes, despite the fact that a 27-foot clear height was required. The 8-inch concrete floor slab over the gymnasium is supported by heavy concrete beams; this meets overhead shielding requirements. The shelter facility can accommodate 1,080 persons with a protection factor of 1,000 (considerably above the minimum level recommended by the Office of Civil Defense).

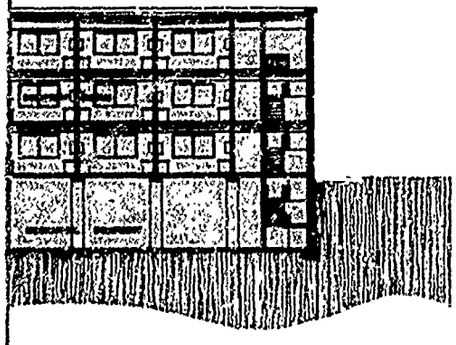
The gymnasium shelter space is air-conditioned. Emergency power is available from a 15-KV generator placed in the mechanical room. City ordinances require the installation of emergency generators in public buildings as part of the normal building requirements.

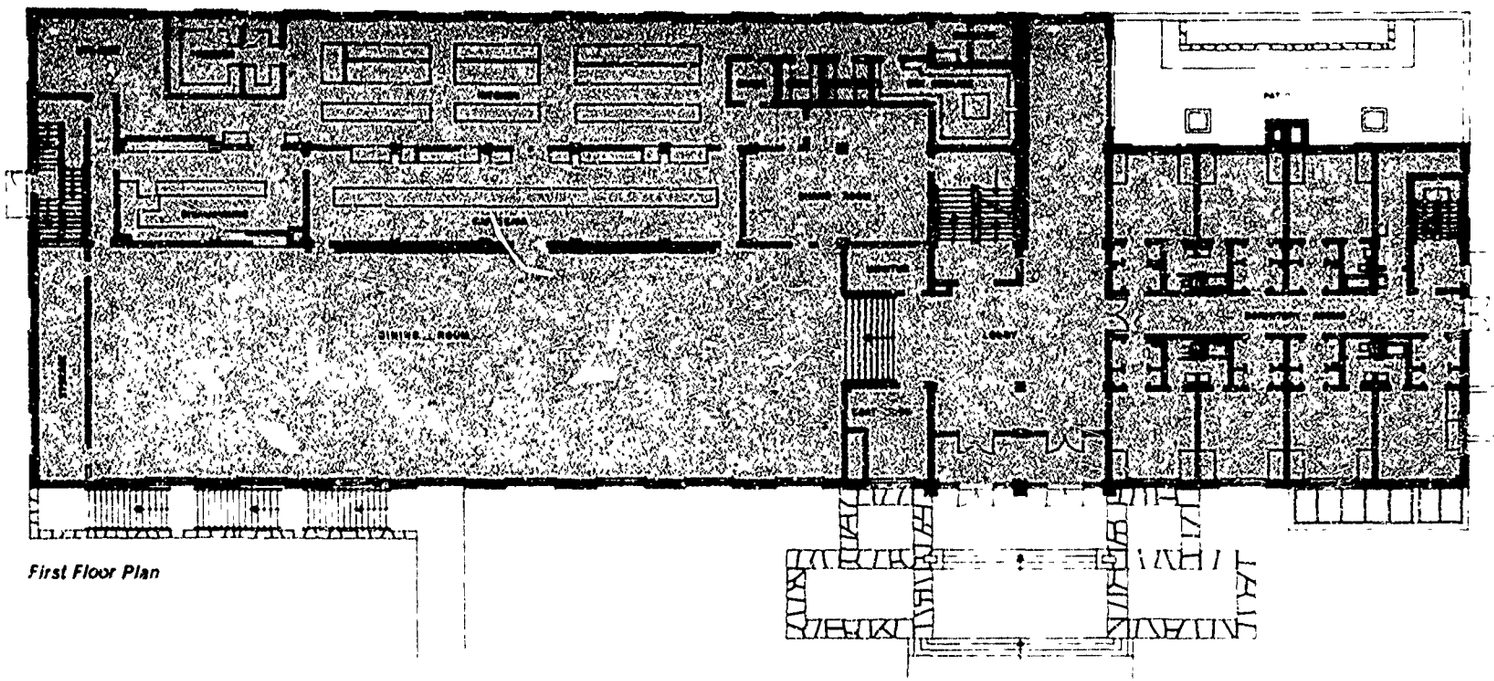


Section

Construction Cost:
$1,296,000 or $18.53 per sq. ft.
Shelter Area:
10,828 sq. ft.
Shelter Cost:
None—inherent in basic design

Section

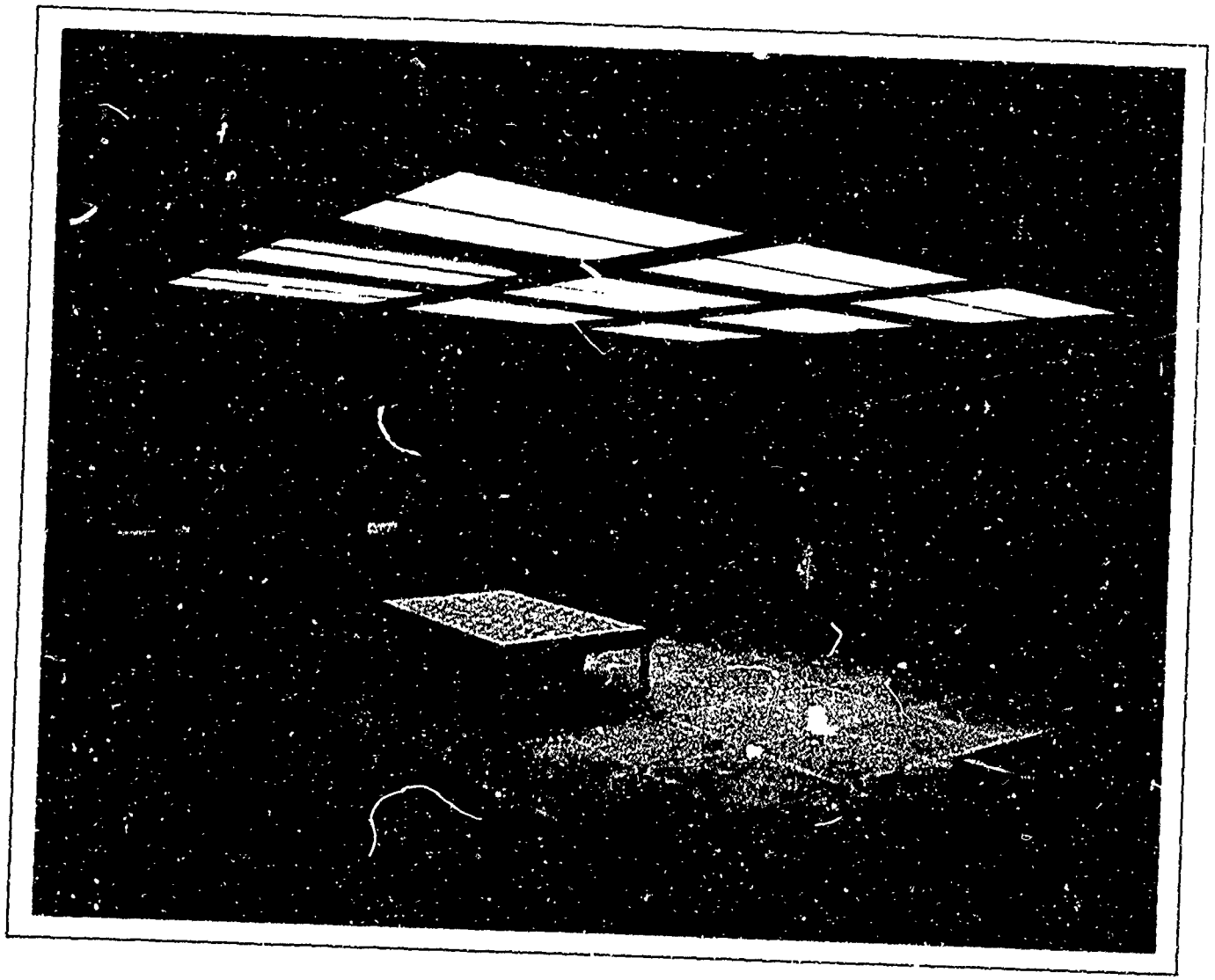




First Floor Plan

Basement Plan

Basement Plan



U.S. Forest Service Research Laboratory

Tempe, Arizona
Stephens, Walsh, Emmons & Shank
Engineers—Architects
Phoenix, Arizona

The research laboratory recently constructed by the U.S. Forest Service in Tempe, Arizona, illustrates how geometric configurations and material selection can provide fallout protection as an inherent feature of design.

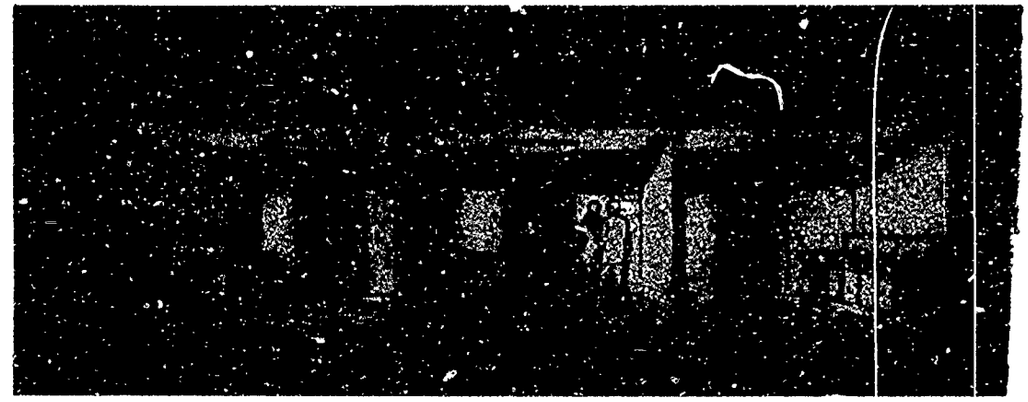
The air-conditioned laboratory is a two-story, aboveground structure that utilizes heavy reinforced-concrete floors, roof and walls; this construction is typical for this area of the country. To reduce maintenance costs, windows in the exterior walls were minimized. Shelter for 73 persons is located in the three laboratory rooms in the center of the first floor. The combined thickness of the roof and the second-floor slab provides overhead shielding, and the exterior walls in conjunction with masonry interior partitions provide vertical shielding.

Fallout protection is inherent in the design utilized for this structure and was accomplished at no additional cost. There was no interference in any way with the function or utility of the building.

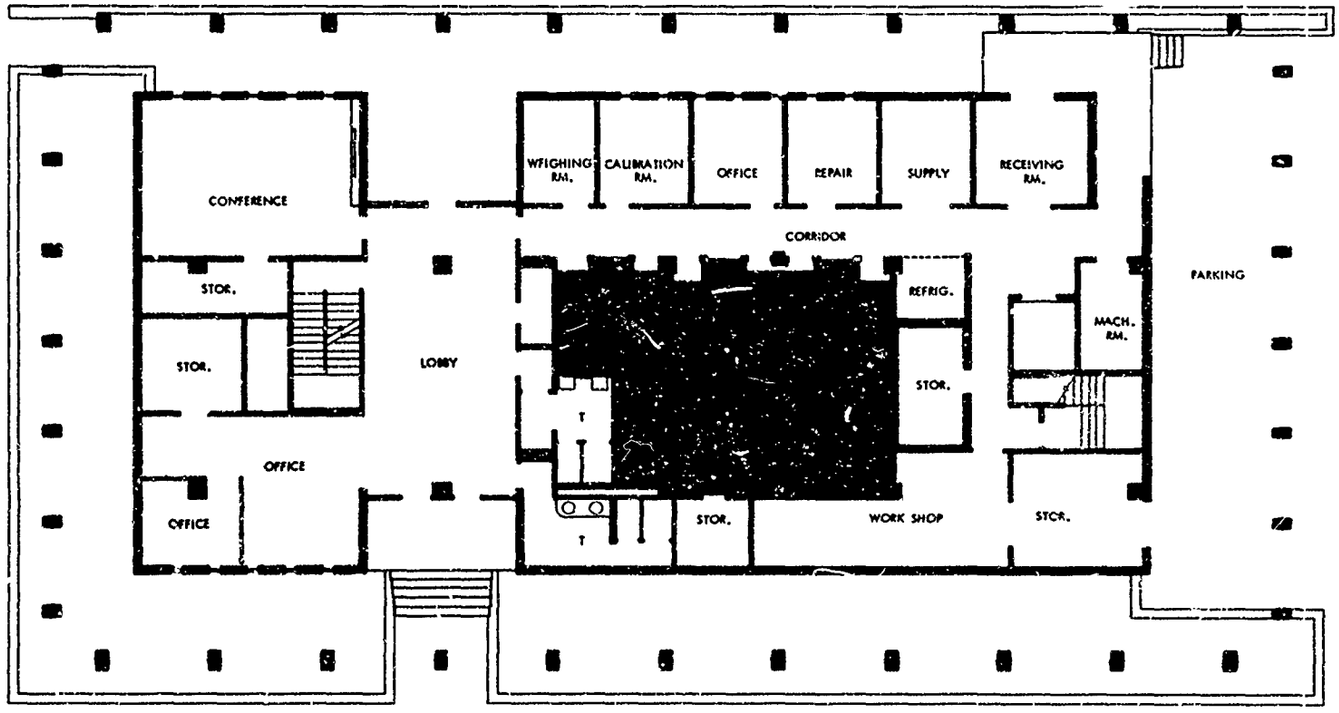
Construction Cost:
$400,710 or $24.74 per sq. ft.

Shelter Area:
736 sq. ft.

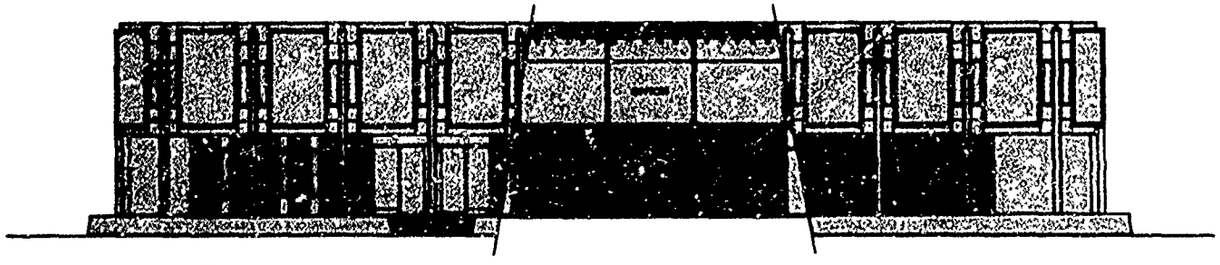
Shelter Cost:
None—inherent in basic design



Sectional Perspective



First Floor Plan



Elevation-Section

Somerset County Home for the Aged

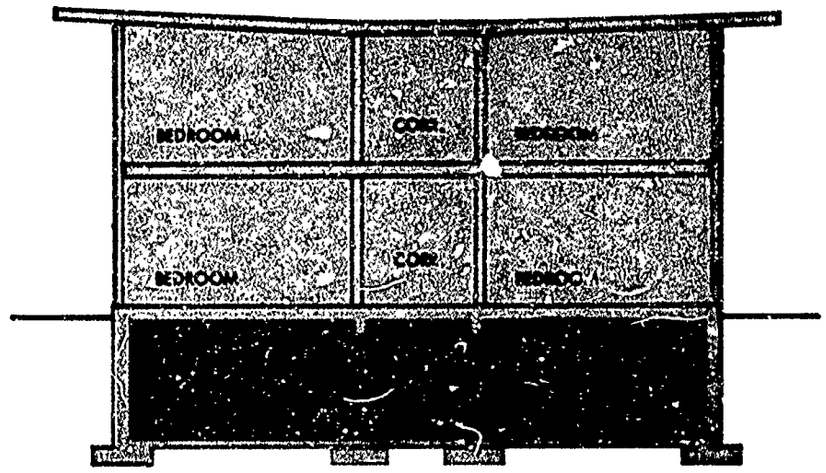
Somerset, Pennsylvania
J. Richard Ross, AIA and
Edwin O. Cramer, AIA
Architects
Somerset, Pennsylvania
J. Richard Ross, AIA, Shelter Analyst

The new Somerset County Home for the Aged has been designed to care for the increasing needs of elderly persons in the County who cannot pay for prolonged private hospital and nursing care.

The superstructure of the building is of steel frame construction that utilizes varicolored porcelain steel-insulated curtainwall panels enhanced by large expanses of grey heat-absorbing glass. Masonry walls at the ends of the buildings are faced with blue glazed brick. Three sections of the building, including the infirmary wing, men's dormitory and service wing, are one-story; the women's dormitory wing has a complete basement and a two-story section.

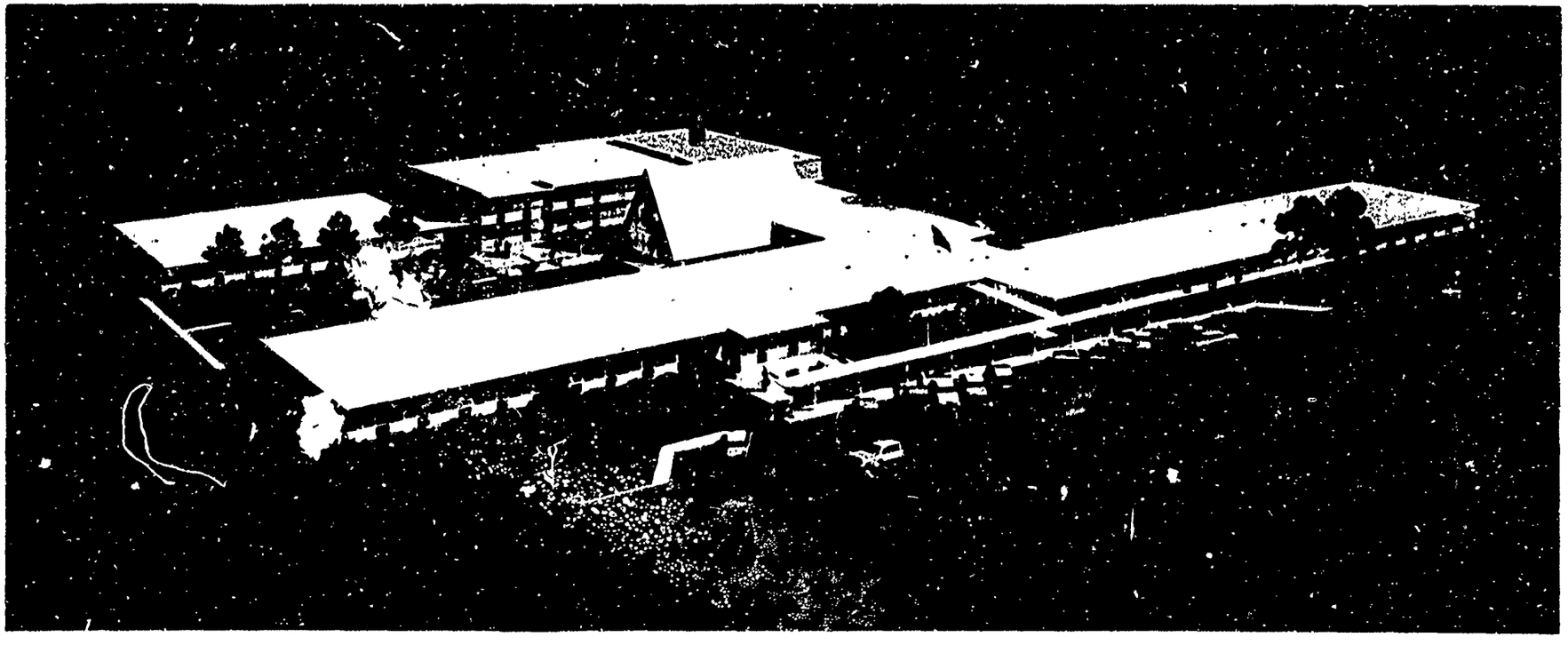
Fallout protection has been provided in the basement area under the women's dormitory wing by use of a 12-inch thick reinforced concrete floor slab instead of an 8-inch slab. One large room, designed as the patient fallout shelter, will handle the entire population of the home. The rest of the area is available as public fallout shelter space. Complete emergency facilities for food, water, toilet, light and ventilation have also been provided.

Construction Cost:
$1,080,000 or $17.26 per sq. ft.
Shelter Area:
10,000 sq. ft.
Shelter Cost:
$10,250 or $0.17 per sq. ft. of building area



Section

Basement Plan



xterior Perspective

Southeast Polk Senior-Junior High School

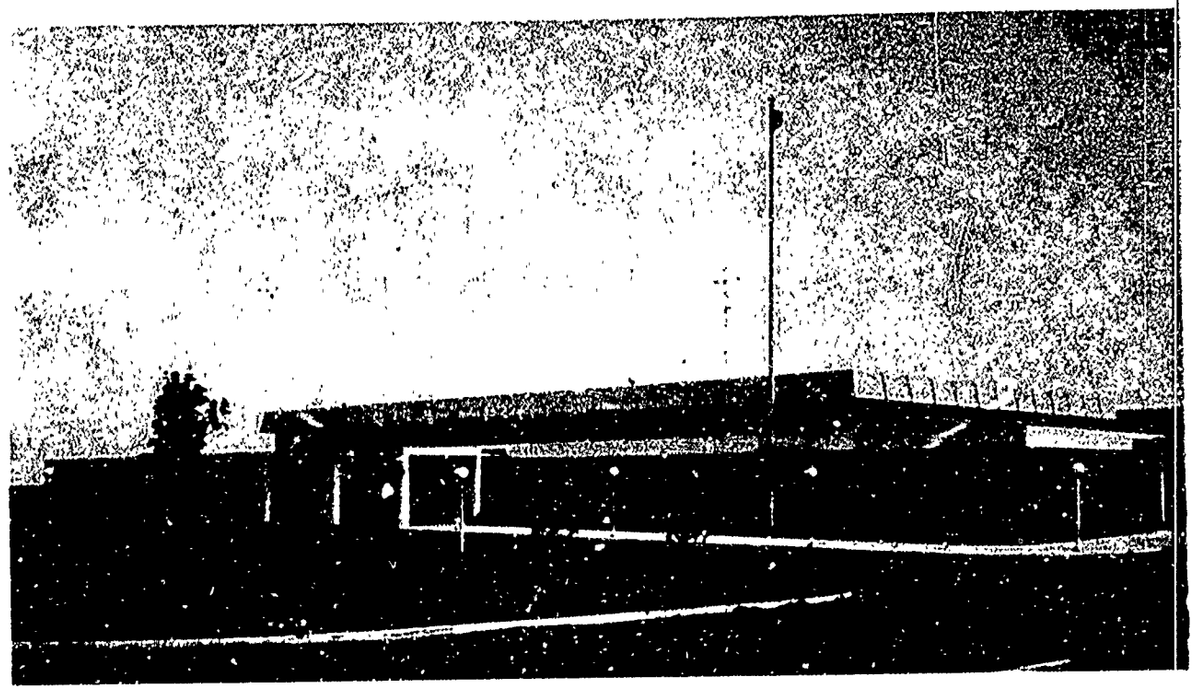
Ivy, Iowa
Dougher-Frevert-Ramsey, AIA
Architects-Engineers
Des Moines, Iowa
W. Robert Ramsey, AIA, PE,
Shelter Analyst

The Southeast Polk Senior—Junior High School complex is essentially a one-story section built around a two-story reinforced-concrete frame core. Classrooms located on the first floor of the academic wing surround the central library, open study-cafeteria rooms and locker areas for junior high and senior high students. A landscaped interior court separates the academic wing from the gymnasium, the band-choral rehearsal room and the industrial shop areas.

The school has a capacity of 1,200 students, but more than 1,700 persons can be accommodated in the fallout shelter area which is located in the library and cafeteria-study areas.

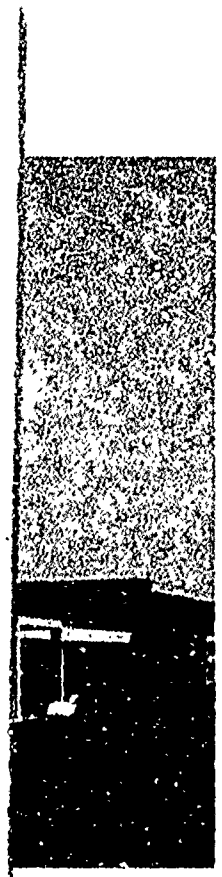
The academic area is air-conditioned, and windows in the exterior classrooms have been minimized. A deep-water well and a standby emergency generator, provided as part of the school requirements, are available for use by shelter occupants in an emergency.

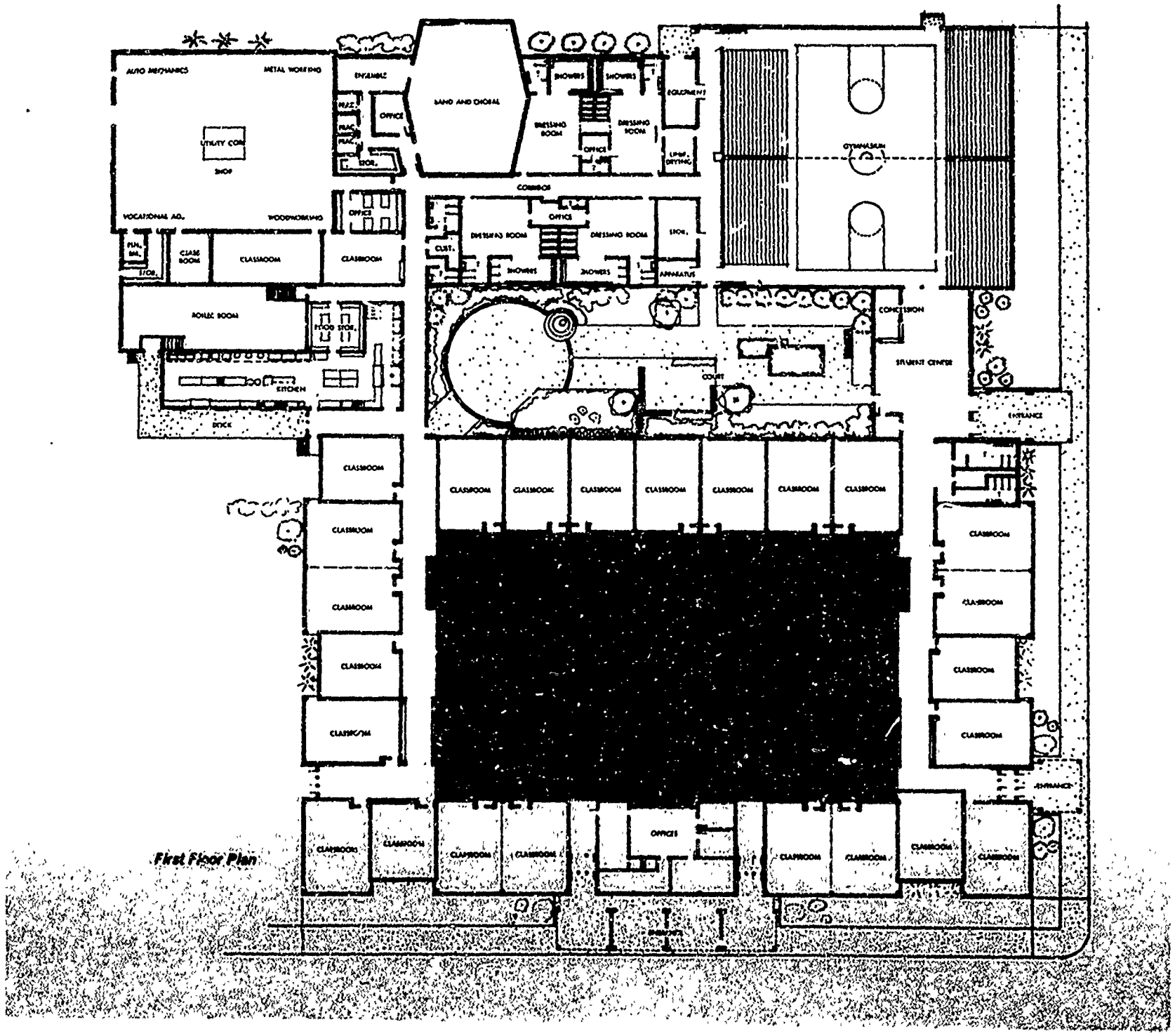
The Southeast Polk school was selected as the Nation's School of the Month* by a committee representing the National Council on Schoolhouse Construction.



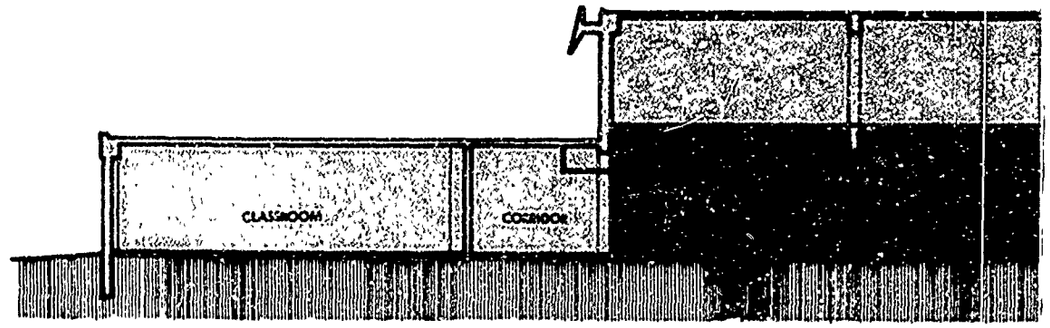
Construction Cost:
$1,715,941 or $17.16 per sq. ft.
Shelter Area:
17,640 sq. ft.
Shelter Cost:
None—inherent in basic design

**Nation's Schools Magazine—October 1965*

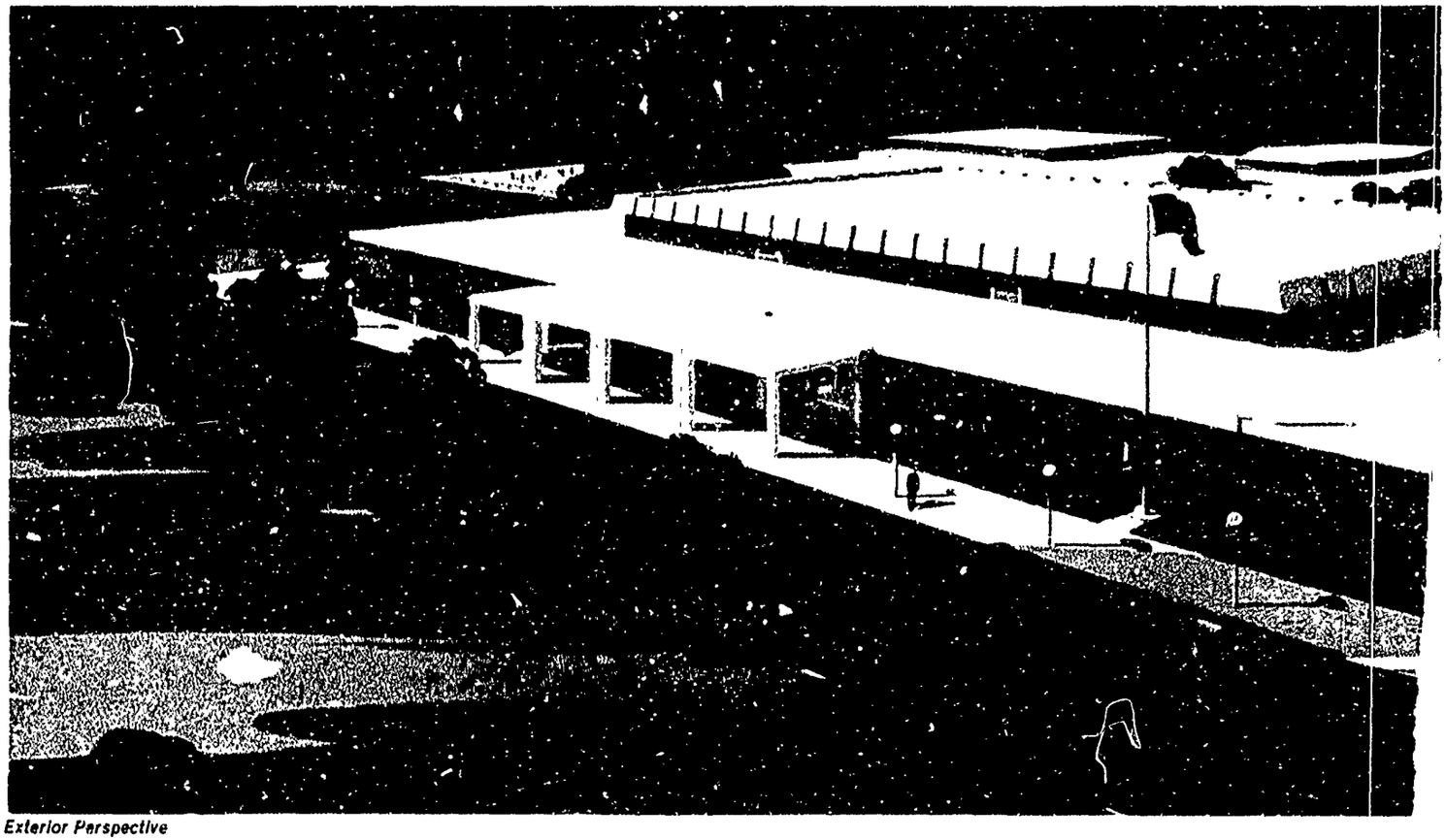




First Floor Plan

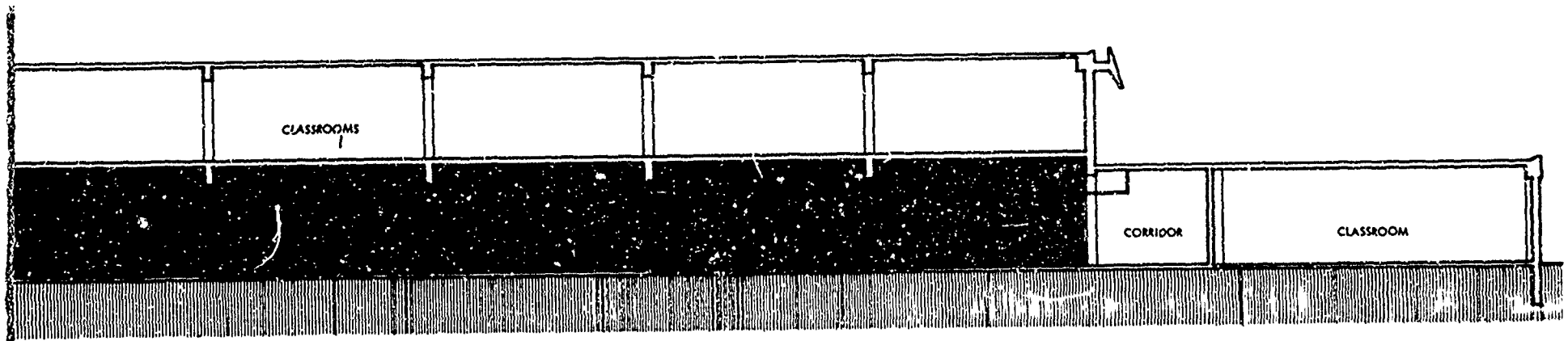


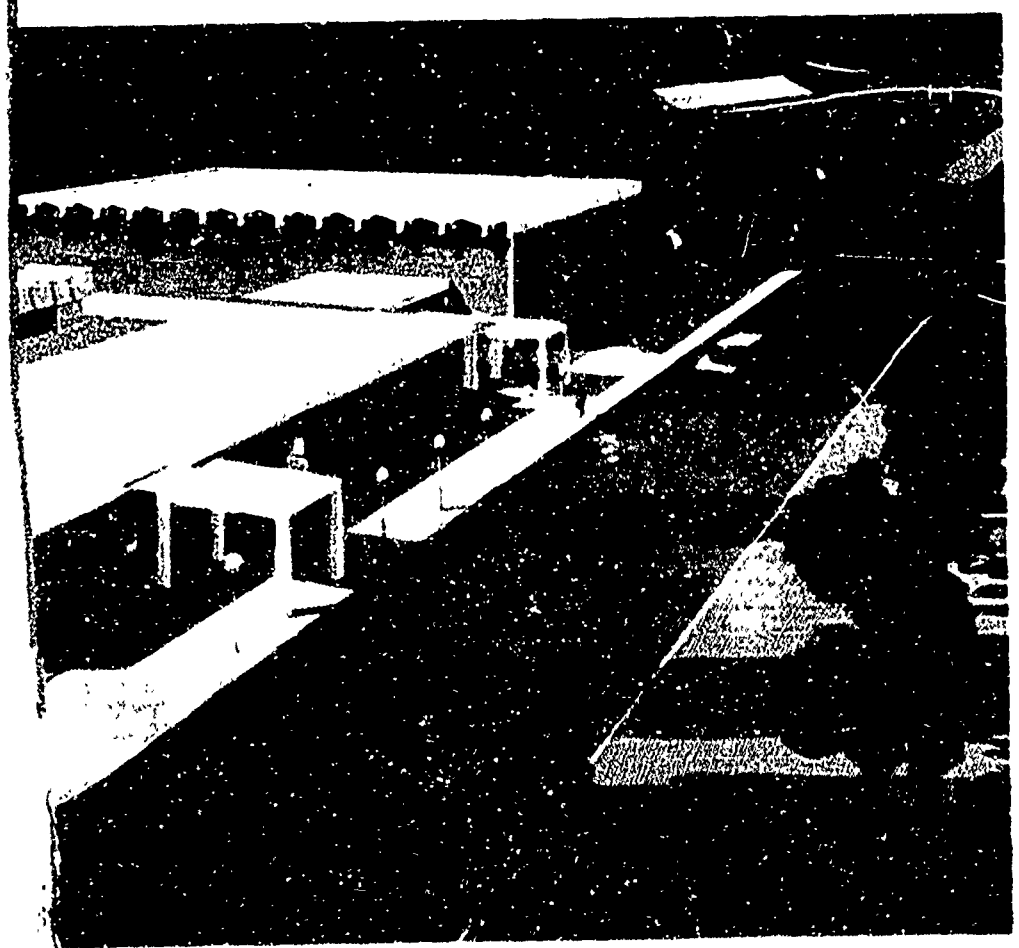
Section



Exterior Perspective

Exterior Perspective





Wilkes Power Plant
Southwestern Electric Power Company

Marion County, near Jefferson, Texas
Sargent & Lundy, Architect-Engineer
Chicago, Illinois
T. L. Pettikas, Shelter Analyst
Chicago, Illinois

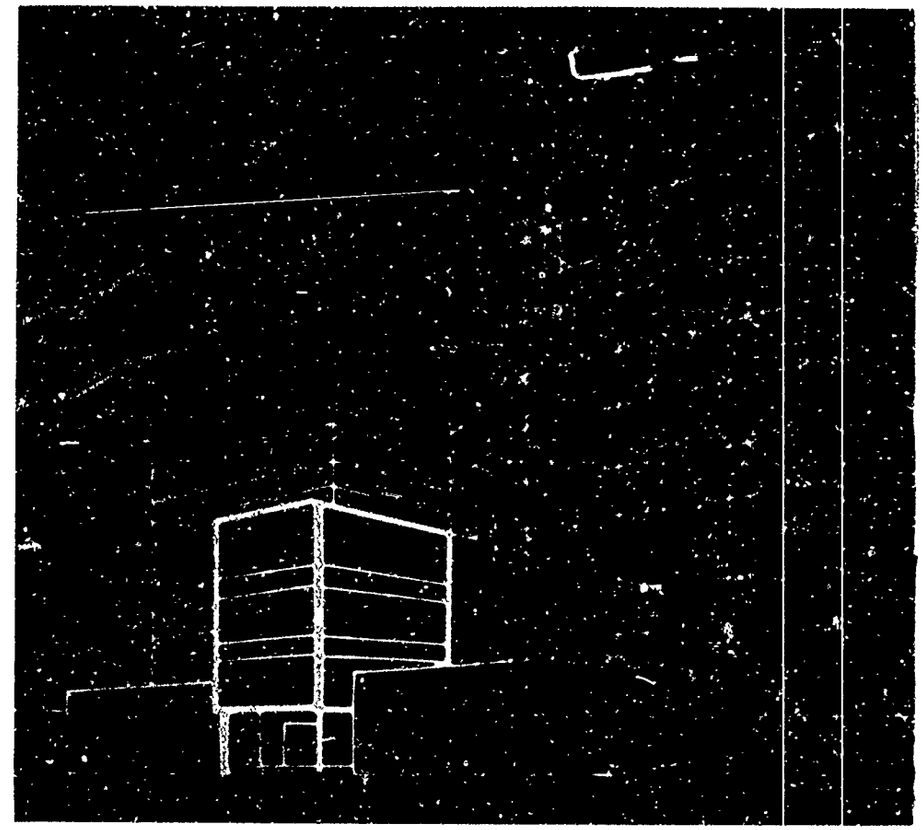
Since the Wilkes Power Plant is located in a rather remote area several miles from other fallout shelter facilities, the owners found it desirable to incorporate shelter facilities in the design of the plant. In an emegency, the shelter will be available for plant personnel and their families who live nearby.

The shelter is provided in an area normally used as a storeroom. Only minor design changes were required to adapt the space as a shelter with a protection factor of 100 for 85 persons. The room was constructed without windows. Brick wall thickness was increased, from a normal 12 inches for exterior walls and 8 inches for interior walls to 23 inches. The roof is constructed of 4-inch poured concrete in place of the normal 3-inch pre cast slab.

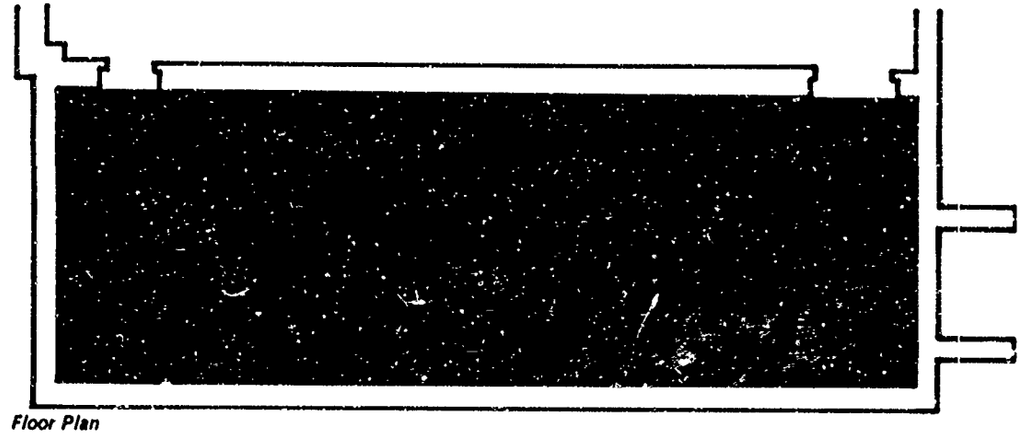
Sanitary facilities are available through a knock-out panel to the adjacent women's toilet facility; also accessible through another knock-out panel is a janitor's closet that would be used as a decontamination room. A shower is installed herein for this purpose.

The space is ventilated by a 600-cfm draw-through fan, with the filtered-air intake located on the inside wall.

Construction Cost:
$14,100,000
Shelter Area:
1,825 sq. ft.
Shelter Cost:
General Construction: $3,965
Mechanical Equipment: $1,000



Diagrammatic Perspective



Floor Plan

1,925 sq. ft.

Shelter Cost:

General Construction: $3,965

Mechanical Equipment: $1,000

Floor Plan

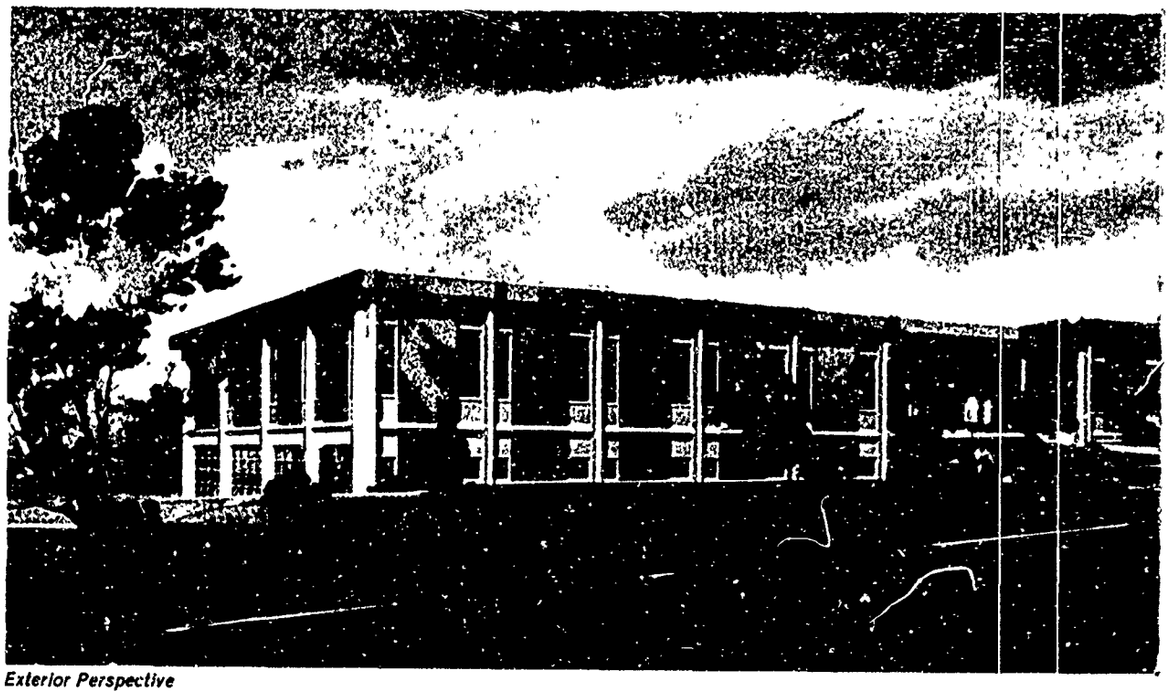
Cookeville City Hall

Cookeville, Tennessee
Rodgers and Rodgers, AIA, Architects
Nashville, Tennessee
William L. Waggoner, Shelter Analyst
Nashville, Tennessee

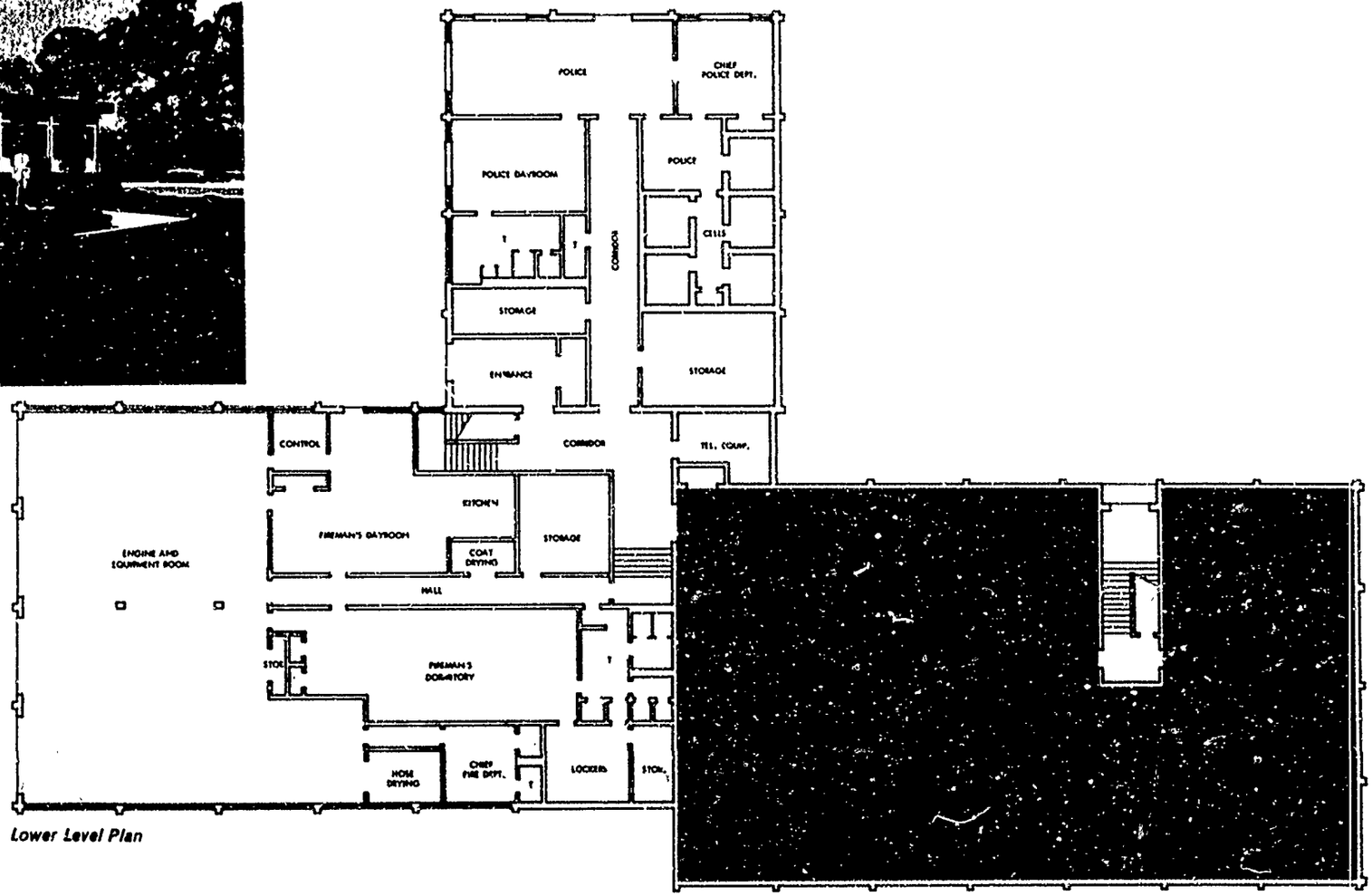
This recently built city hall is a two-story structure, with the first story belowgrade. The building houses the city government agencies, which include city council, police, fire, gas, electrical, tax and water departments. The basement area is used by the police and firefighting departments and provides space for fire engines and firemen's dormitory. Also included is a storage area and space for future expansion of city department activities.

Fallout shelter is located in the storage area and future expansion space in the basement. It was obtained at no increase in cost, being inherent in the design. The overhead concrete floor system was of sufficient thickness to provide shielding from the roof contribution. Vertical shielding was obtained through use of heavy masonry walls.

Construction Cost:
$649,000 or $20.23 per sq. ft.
Shelter Area:
5,100 sq. ft.
Shelter Cost:
None—inherent in basic design



Exterior Perspective



Lower Level Plan

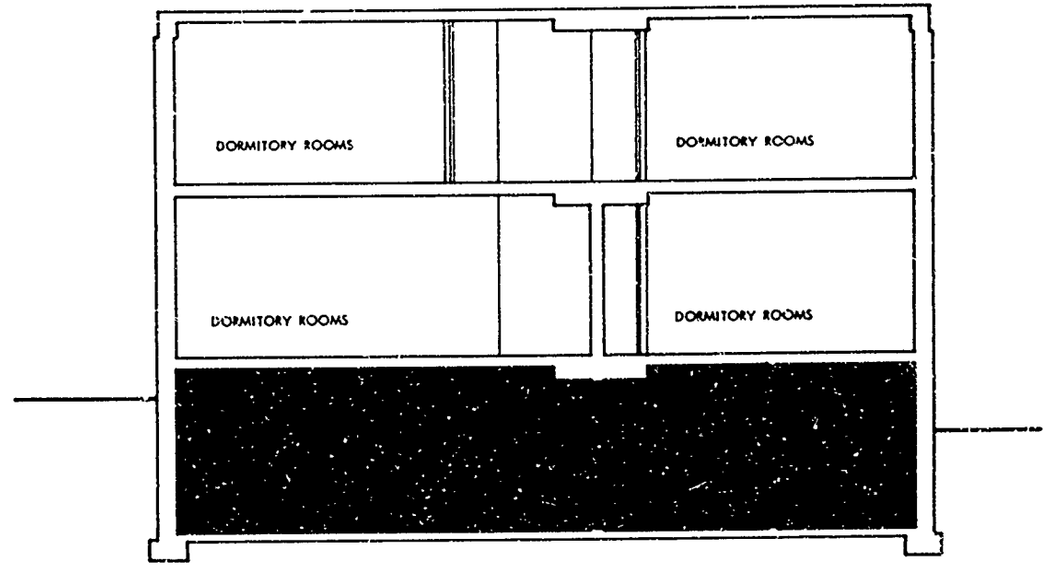
McCloud Hall Girls' Dormitory
York College

York, Nebraska
Carmichael-Wheatcroft & Associates, AIA
Architects-Engineers
Wichita, Kansas
Lyle Wheatcroft, PE, Shelter Analyst

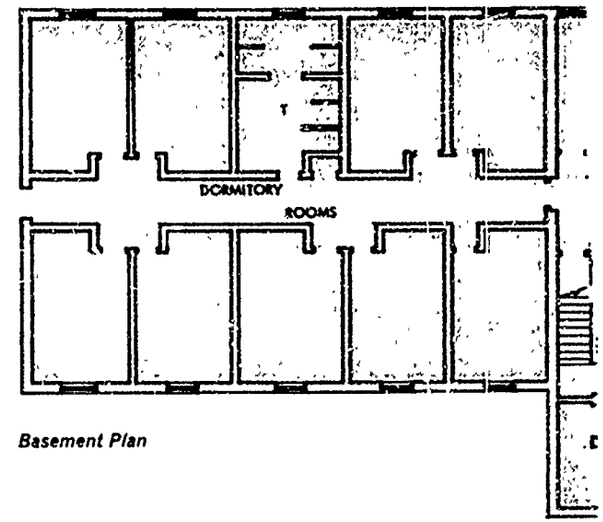
This recently constructed girls' dormitory building at York College is a three-story structure, with the first floor partially belowgrade. The dormitory houses 137 college students. Shelter space for 180 persons is available in the central portion of the first floor. This area contains a recreation room, laundry room, snack room and typing and practice rooms.

Shelter was attained by using a poured-in-place concrete floor slab system with sprayed-on acoustical ceilings instead of a slab supported by steel bar joists. Use of this heavier type of floor system, for the two floors and roof, resulted in lowering the overall building height approximately 4 feet. The dollar saving thus attained was almost enough to offset the cost of using the heavier floor slab system; the difference was $1,500. To improve the fallout protection in the shelter area to a protection factor of 145, windows were omitted from the middle portion of the first-floor level. No additional structural changes from normal construction were necessary to provide vertical shielding for the shelter area since the exposed basement walls were built of 12-inch concrete.

The lighting system was designed with auxiliary sockets in the fixtures in the shelter area. A 3.5-KW gasoline engine generator is available to provide power if needed in an emergency. A fan system in the shelter area has also been provided to improve ventilation if required.



Section



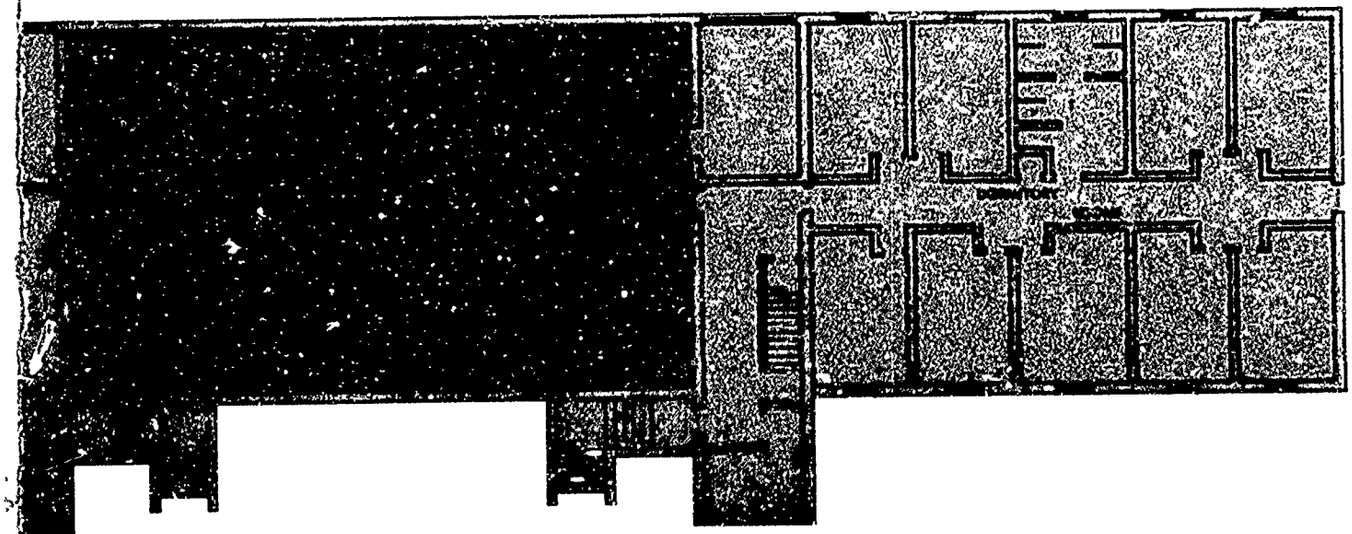
Basement Plan

Construction Cost:
$244,671 or $10.24 per sq. ft.
Shelter Area:
2,430 sq. ft.
Shelter Cost:
General Construction: $1,500 or $0.06 per sq. ft. of building area
Electrical Equipment: $2,315

vide power if needed in an emergency. A fan system in the shelter area has also been provided to improve ventilation if required.

General Construction: $1,500 or $0.06 per sq. ft. of building area
Electrical Equipment: $2,315

Basement Plan



Headquarters Building
New Jersey Bell Telephone Company

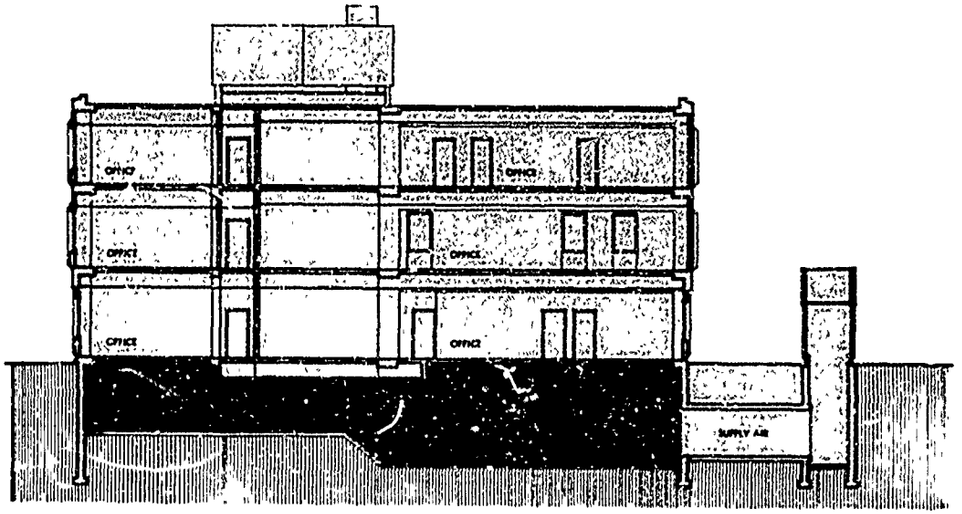
Camden, New Jersey
Eshbach, Pullinger, Stevens & Bruder, AIA
Architects
Trenton, New Jersey
L. Richard Gons, Jr., Shelter Analyst
New Brunswick, New Jersey

Telephone service is so essential to our daily lives that telephone companies build emergency facilities including secondary power generation as insurance. New Jersey Bell Telephone Company is no exception; in fact, it says its designs give "*optimum probability of survival of essential communication services.*" And this includes radiation shielding from fallout. Buildings containing critical services are designed to give fallout protection for operating personnel under working conditions.

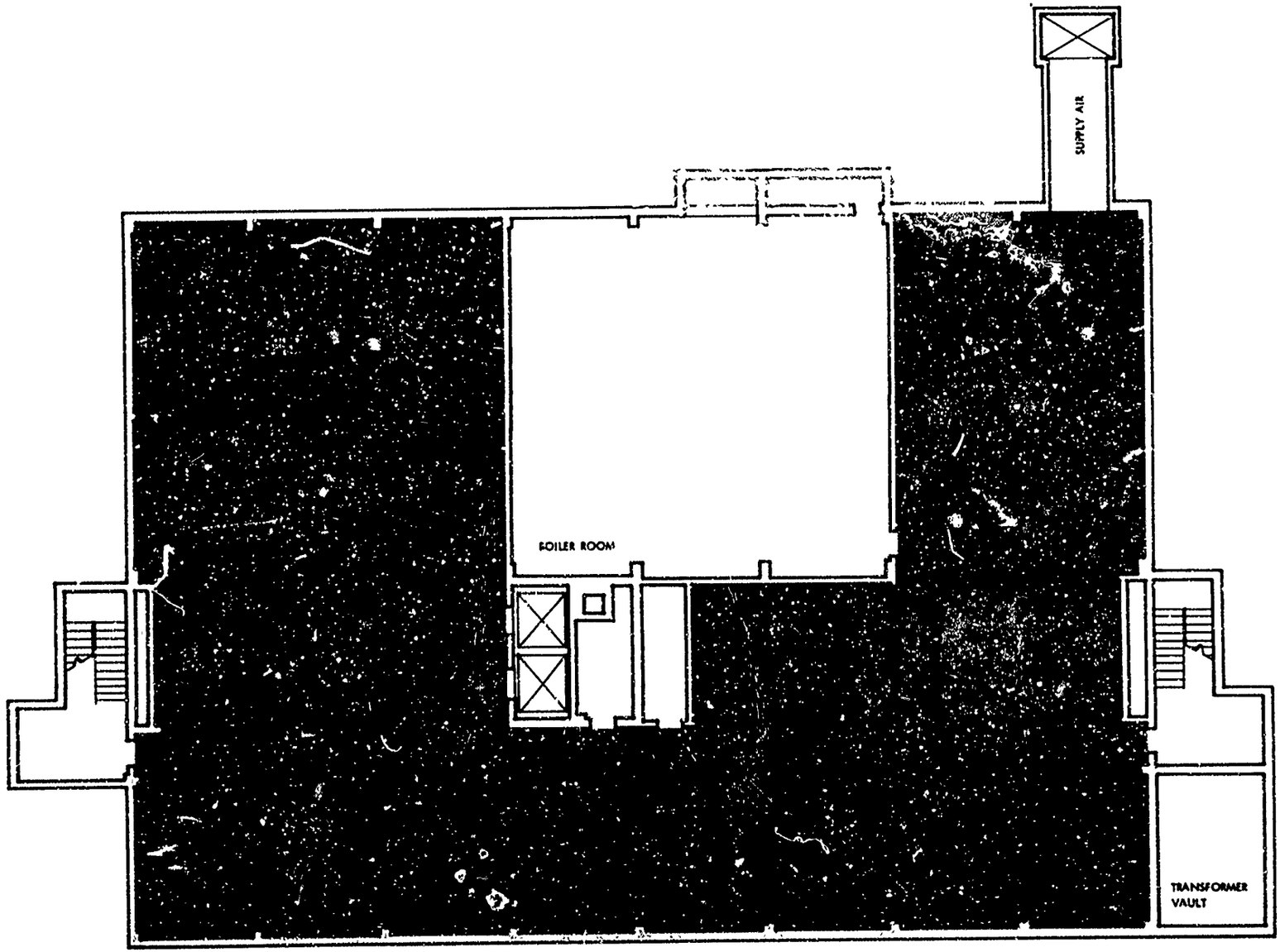
The recently constructed New Jersey Southern Area Headquarters Building is a three-story structure, with the basement partially belowground. The building is located on a gently sloping site, and a retaining wall along the periphery of the building adds barrier shielding to the exposed basement walls. An emergency water tank for fire protection has been included; it will also provide water for shelter occupants in an emergency.

In addition to this building, many of the company's other office buildings are being planned to provide fallout protection by the use of low-cost shielding techniques.

Construction Cost:
$1,150,000
Shelter Area:
10,000 sq. ft.
Shelter Cost:
$5,000 (cost of retaining wall)



Section



Basement Plan

Library Building
University of California

San Diego, California
Deems, Lewis, Martin & Associates, AIA
Architects
San Diego, California

The University Library Building, located on the University of California-San Diego campus, is primarily a four-story reinforced-concrete structure with the first-floor level belowgrade.

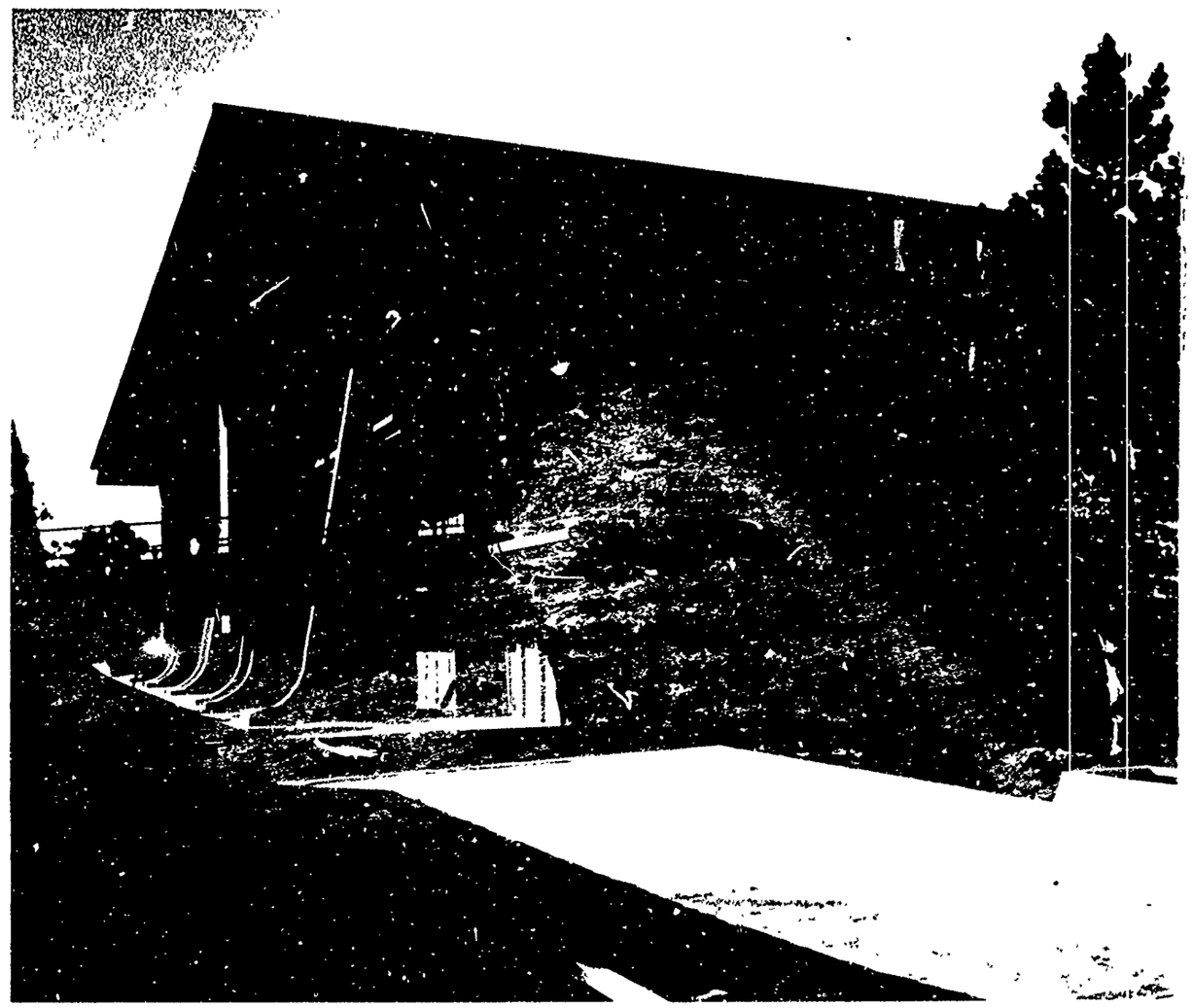
The building design features a large reading room centrally located on the third floor, which receives some natural light from skylights in the roof and from clerestory windows. The abovegrade north and south walls are predominantly glass and have large overhangs.

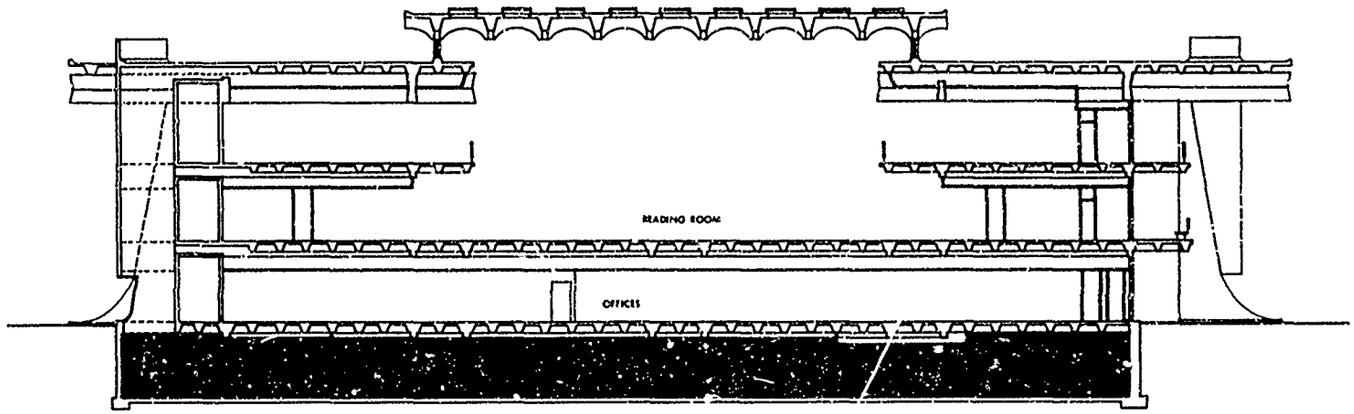
Fallout shelter is located in the basement area which contains the bio-medical library and audio-visual facilities. Shelter space for more than 2,400 persons, sufficient for the entire student population, is available in this building.

Construction Cost:
$2,500,000 or $25.00 per sq. ft.

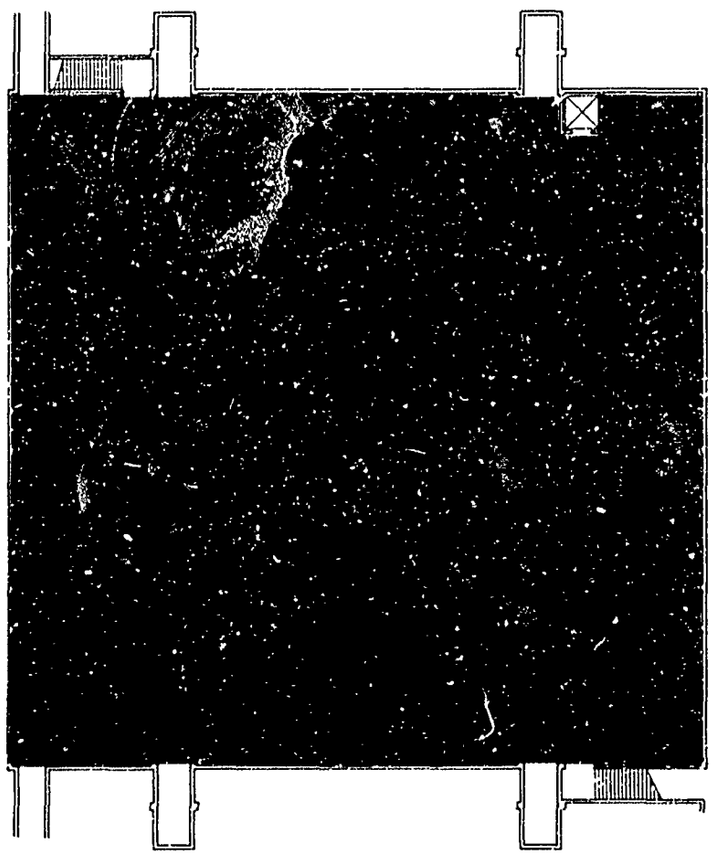
Shelter Area:
24,780 sq. ft.

Shelter Cost:
None—inherent in basic design





Section



Basement Plan

St. Jude The Apostle Church

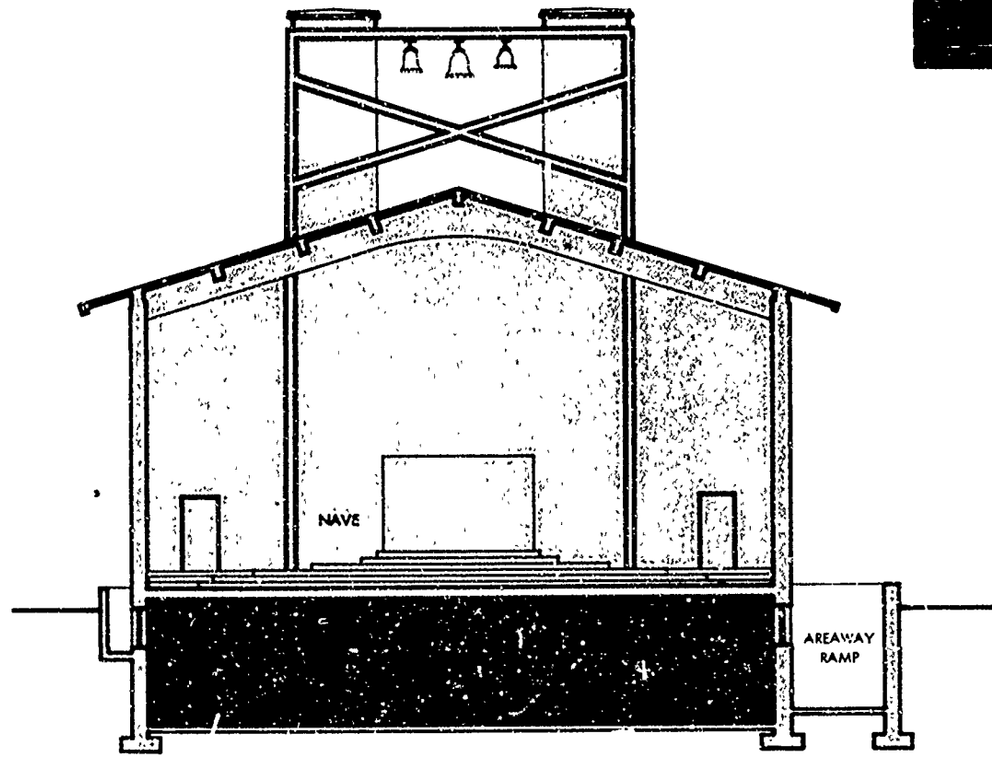
Atlanta, Georgia
Albert O. Ordway, AIA, Architect
and Shelter Analyst
Atlanta, Georgia

The architect for this church project was requested to incorporate fallout shelter primarily for children enrolled in the parochial school located at the same site. Since the church auditorium, several classrooms and meeting rooms were already programmed for the basement area, it was relatively simple to add fallout protection.

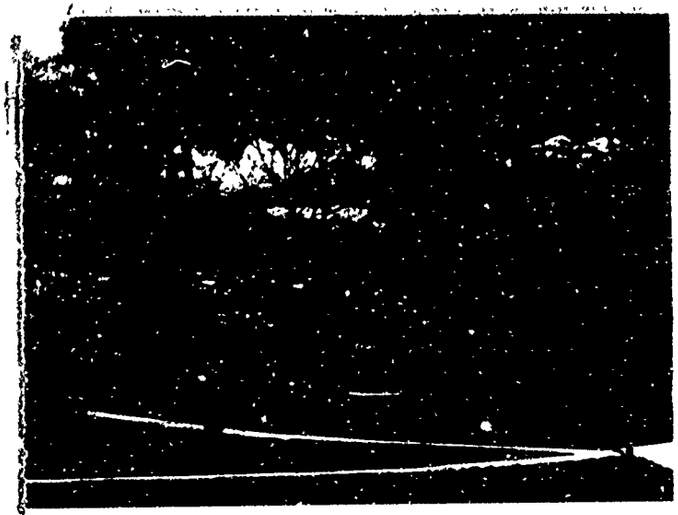
Protection was obtained by use of a heavy reinforced-concrete floor slab over the entire basement area. Windows in the basement auditorium area are shielded through window wells and a retaining wall adjacent to the areaway ramp. The partially exposed wall of the meeting room was given additional shielding by filling the voids of the concrete masonry units with sand and the placement of a granite shielding wall 3 feet, 4 inches high.

In this manner the architect was able to incorporate fallout protection for 856 persons without interfering in any way with the function or utility of the space. The church has a seating capacity of 820 persons.

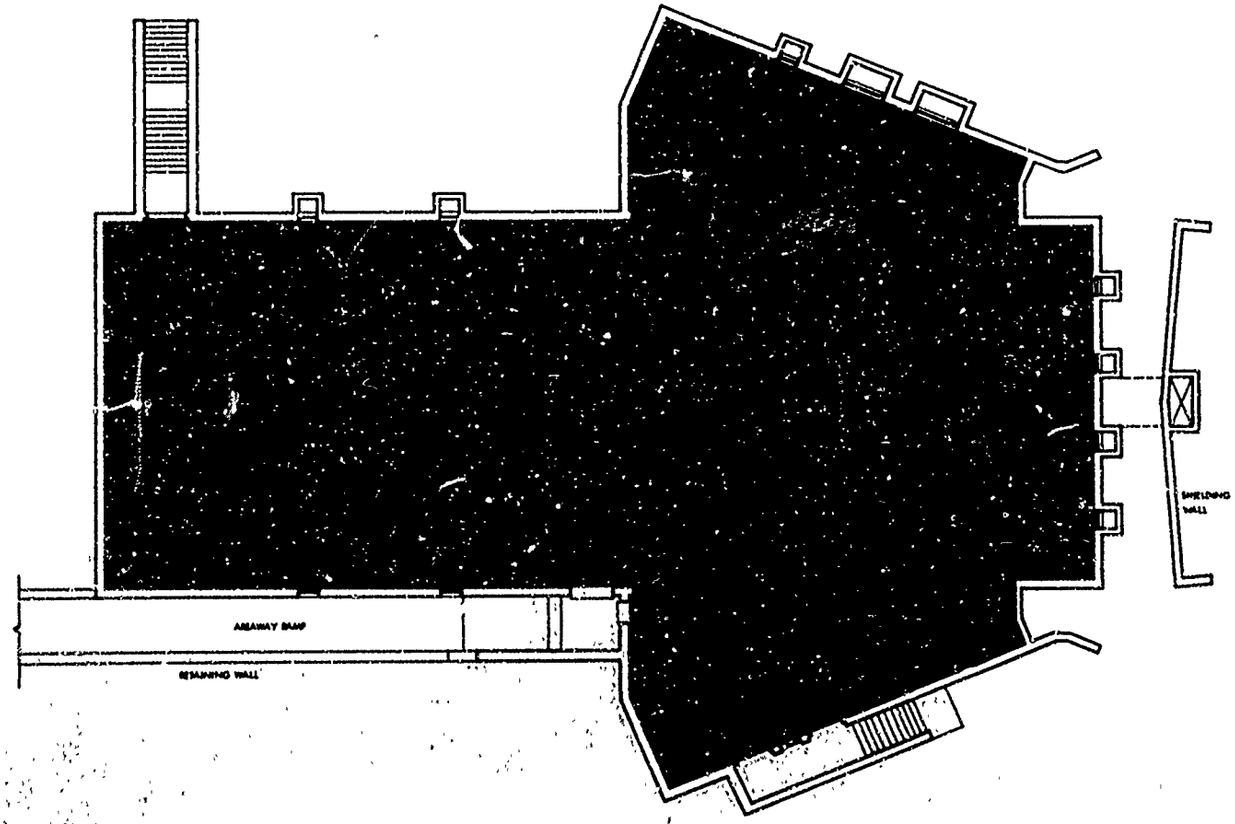
Construction Cost:
$350,000 or $14.40 per sq. ft.
Shelter Area:
10,832 sq. ft.
Shelter Cost:
$8,000 or $0.33 per sq. ft. of building area



Section



Basement Plan



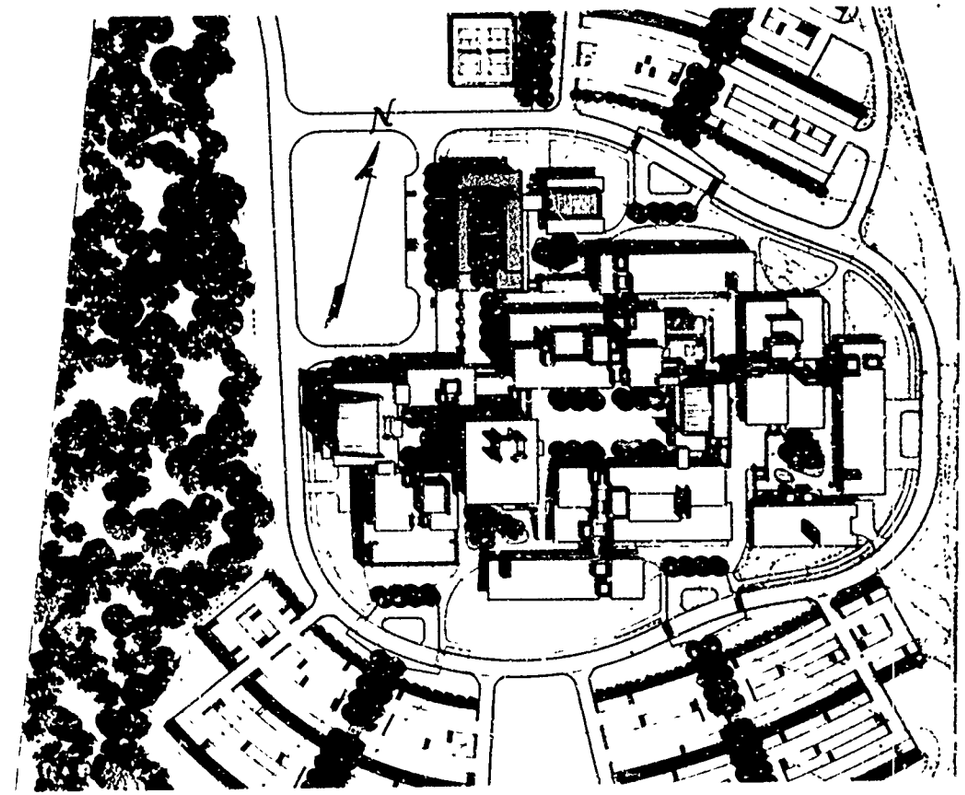
Gymnasium Building
Anne Arundel Community College

Severna Park, Maryland
Anne Arundel County Associated Architects
Earle S. Harder & Associates
Wheeler, Bonn, Shockey & Associates
Rogers, Taliaferro, Kostritsky & Lamb
William H. Harder
Severna Park, Maryland
Dulany F. DeButts, Shelter Analyst
Annapolis, Maryland

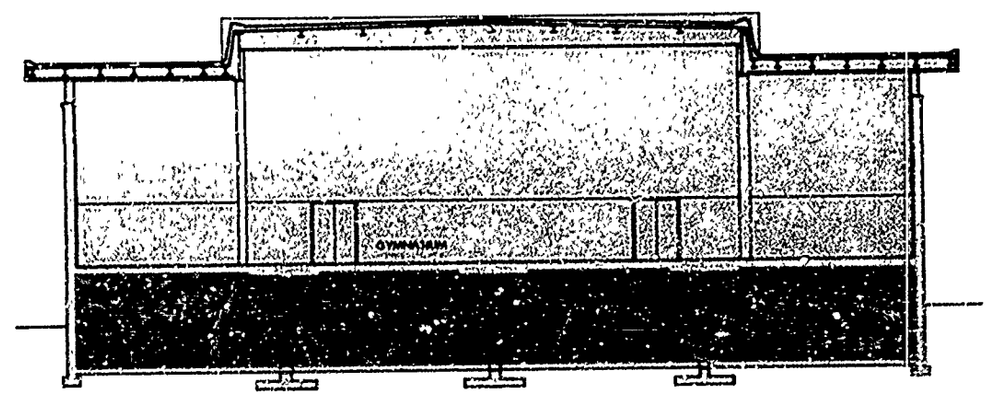
The Anne Arundel Community College is located on the fringe of a large residential area between Baltimore and Annapolis, Maryland. The first of the college buildings to be constructed is the gymnasium. It is essentially a two-story structure, with the ground floor partially belowgrade. A complete indoor gymnasium area is located on the upper level. The ground-floor level contains locker rooms, shower rooms, two classrooms and a wrestling room. The entire ground-floor level is fallout protected.

The protection was obtained through use of a heavy concrete floor over the shelter area, required as part of the normal design, and heavy masonry exterior walls with no windows. Further shielding will be obtained when additional college buildings are constructed adjacent to the gymnasium.

Construction Cost:
$788,000 or $20.00 per sq. ft.
Shelter Area:
10,000 sq. ft.
Shelter Cost:
None—inherent in basic design

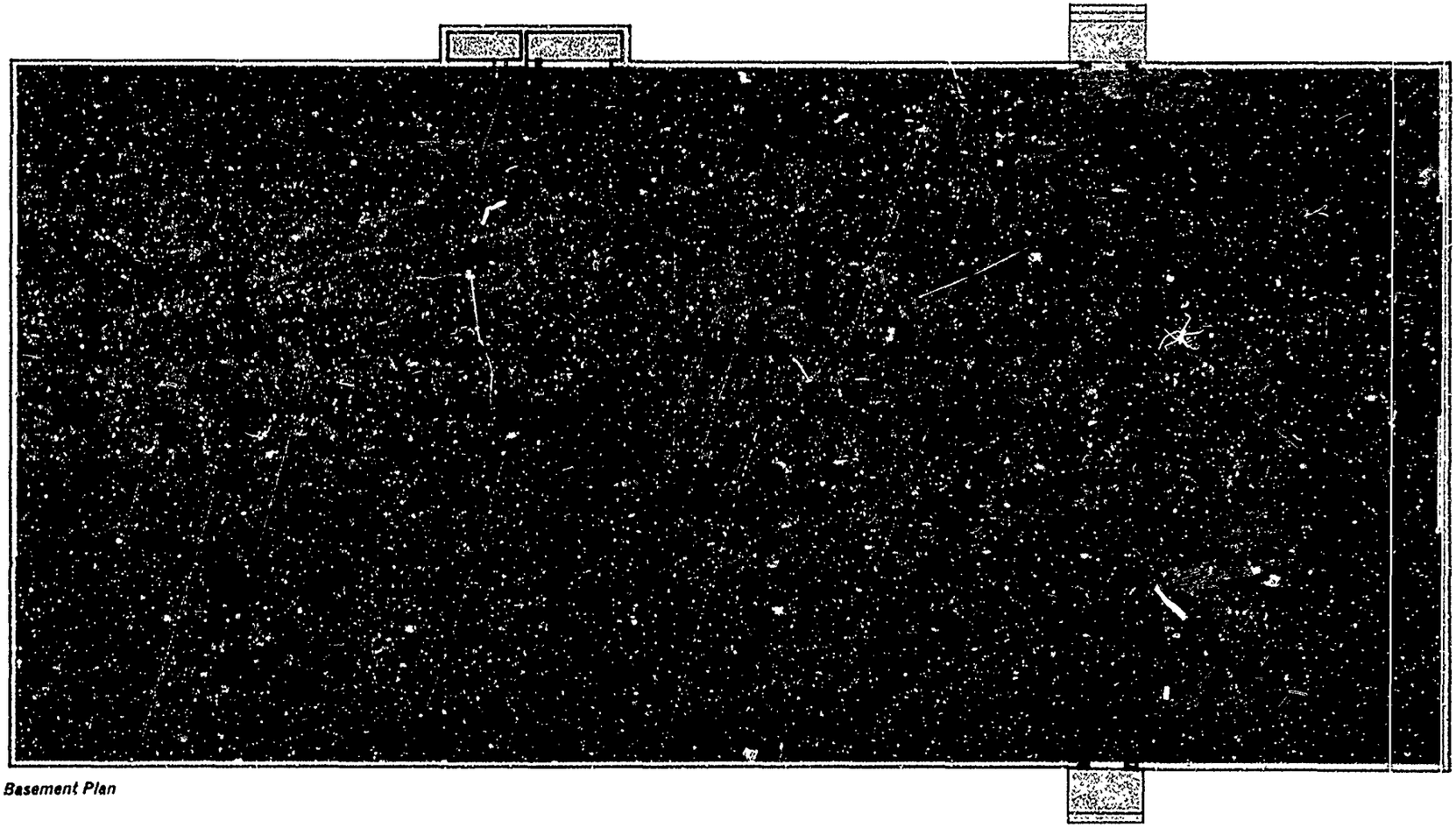


Plot Plan



Section

Section



Basement Plan

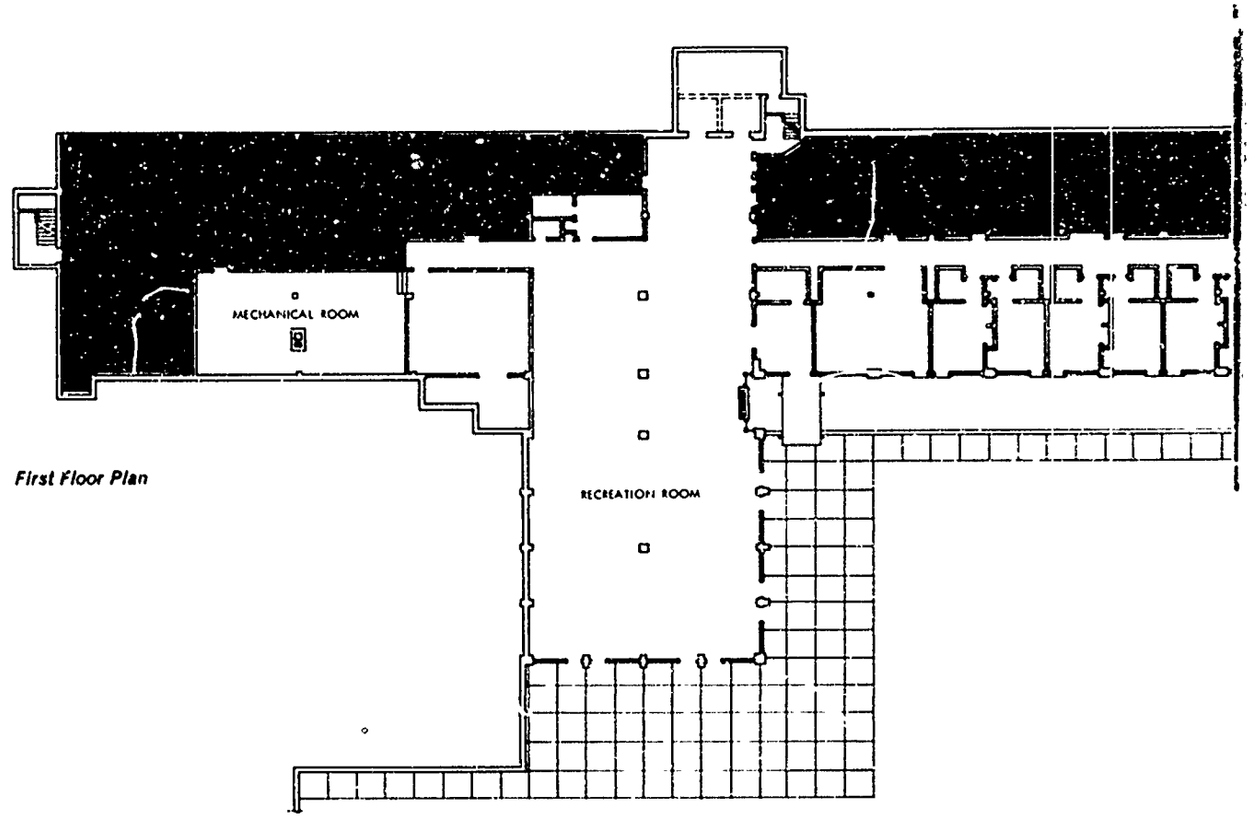
Hillside House
First Community Village

Columbus, Ohio
Tibbals, Crumley, Musson, AIA, Architects
Columbus, Ohio

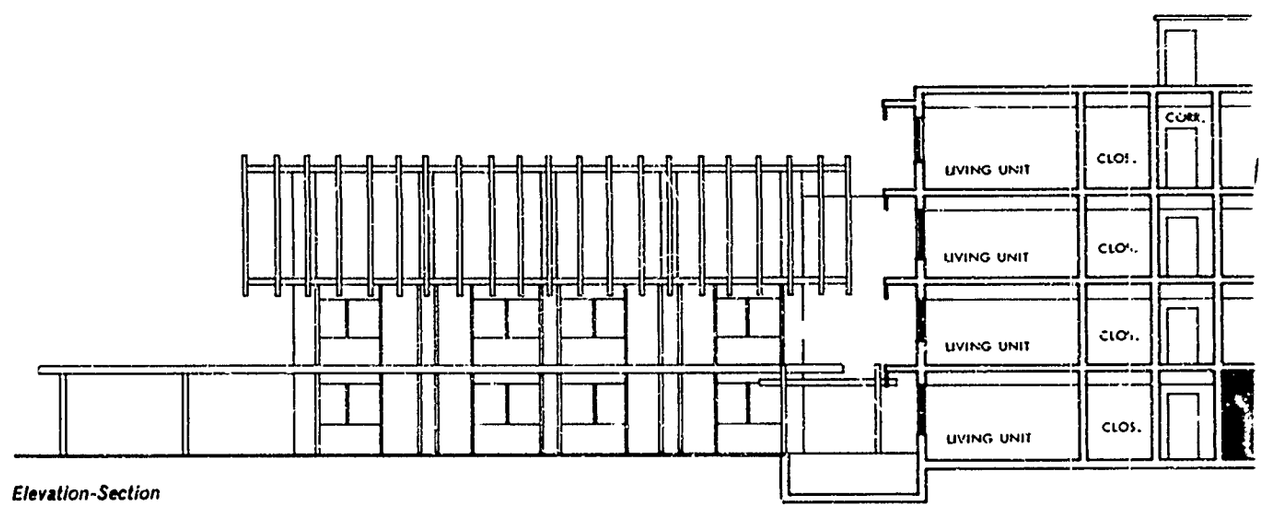
First Community Village is a retirement center built by the First Community Church to provide purposeful and graceful living for persons past 60 years of age. Hillside House, the main building, is the center of activities. The four-story main building contains residence apartments, recreation and meeting rooms, beauty and barber shops, chapel, snack bar, craft rooms, lounges, and administrative offices. It contains 92 single-residence rooms, each with a private bath. In addition, ten single and nine double rooms are located in the infirmary section on the fourth floor. The structure, placed into the side of a hill, appears to be only two stories high when viewed from the east and four stories high from the west.

Fallout protection was incorporated into the first floor of the building at no increase in cost by judicious use of site conditions and selection of materials. The three 9-inch reinforced concrete floors, plus the 9-inch concrete roof, gives sufficient overhead mass to the shelter area. The shelter area is normally used for meeting rooms, storage area and laundry rooms.

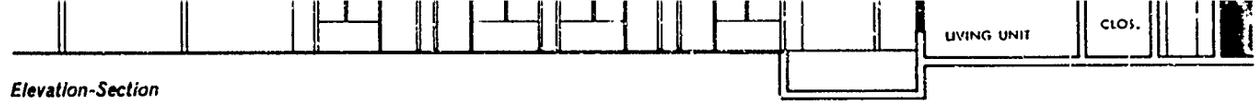
Construction Cost:
$1,300,000 or $15.83 per sq. ft.
Shelter Area:
8,900 sq. ft.
Shelter Cost:
None—inherent in basic design



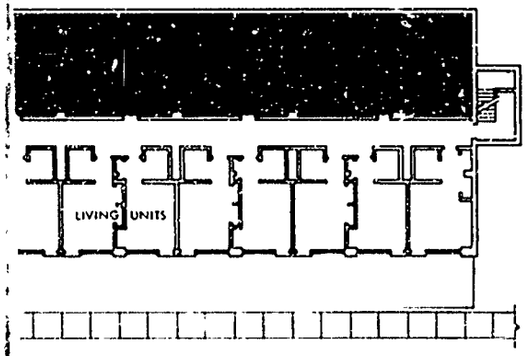
First Floor Plan

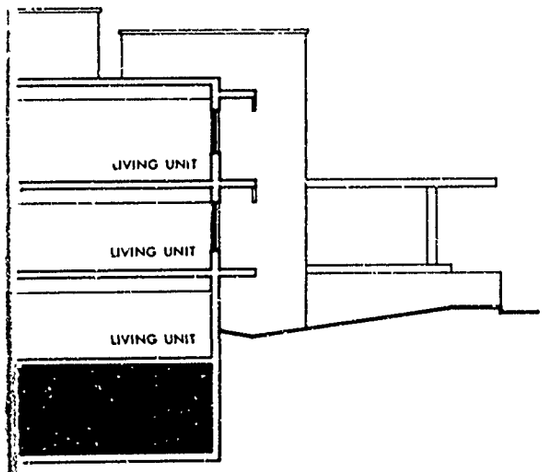


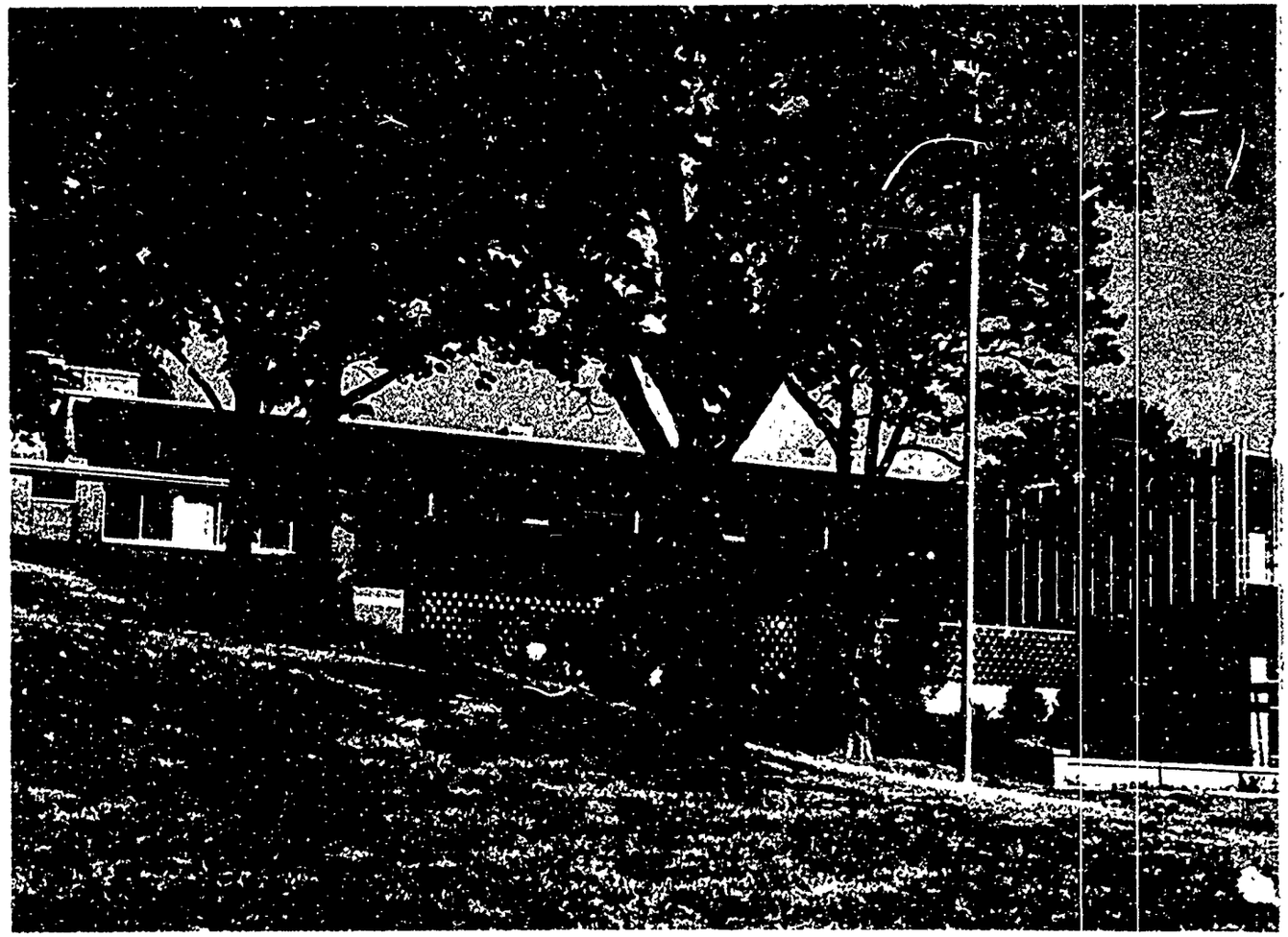
Elevation-Section



Elevation-Section







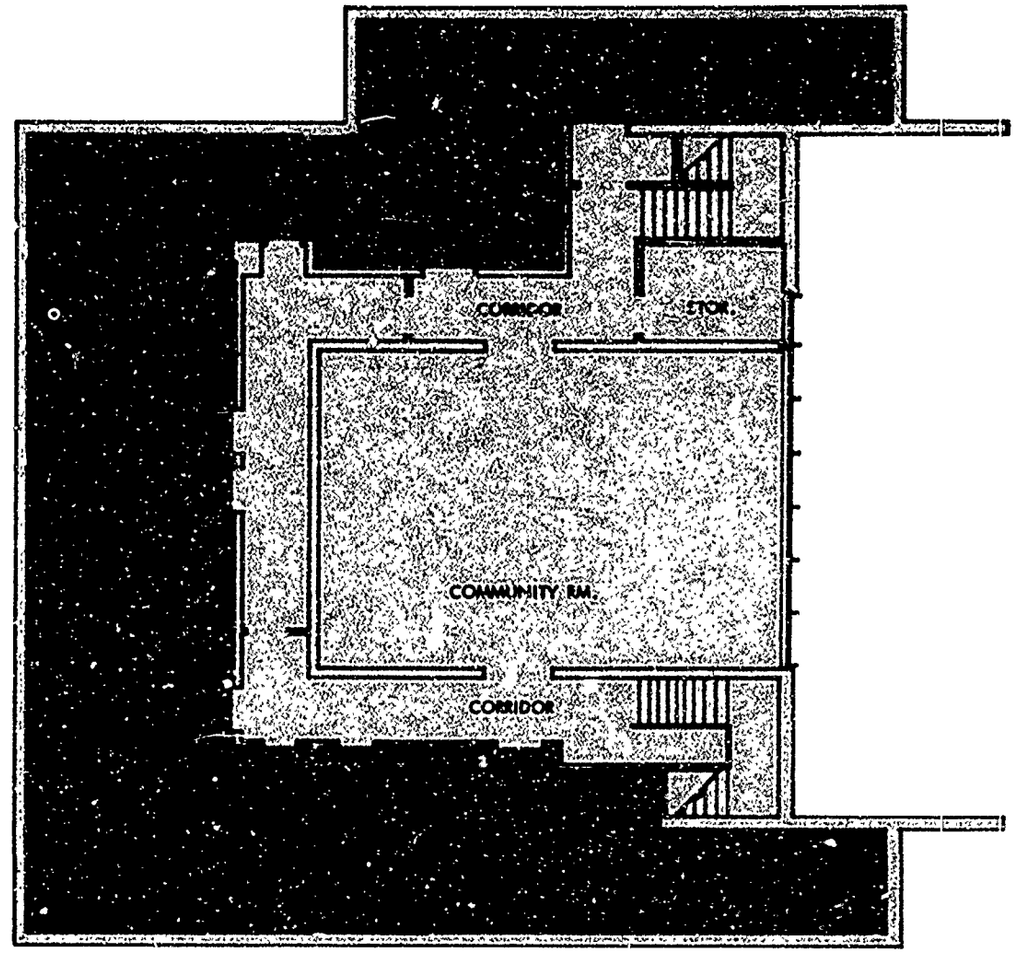
Niagara County Savings Bank

North Tonawanda, New York
Cannon, Thiele, Betz, Cannon, AIA
Architects - Engineers
Niagara, New York
John D. Cannon, PE, Shelter Analyst

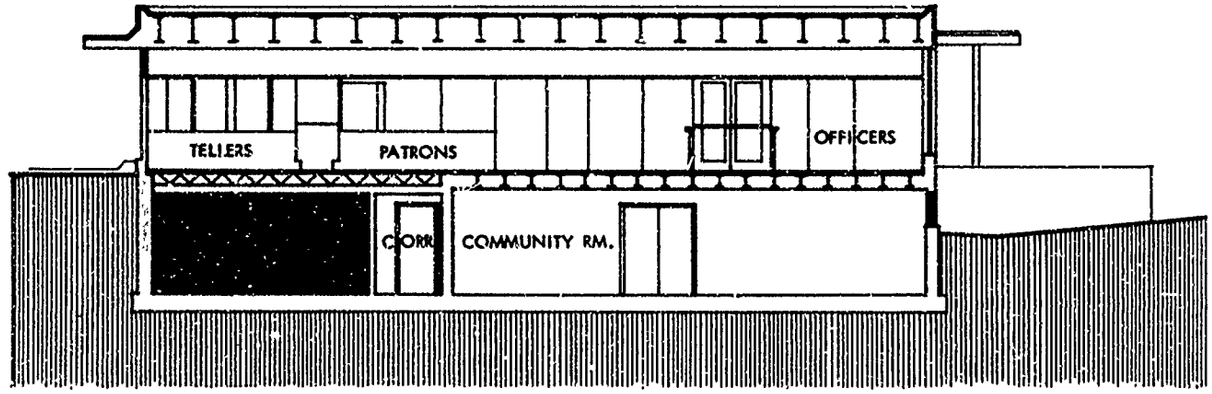
The bank is a one-story structure with a basement area almost completely belowgrade on three sides. The fourth side (north wall) is almost entirely abovegrade and contains a considerable amount of glass. The basement area has a community room, vault, men's and women's lounges, lunchroom and storage areas. Fallout shelter is located in the entire basement area except for the community room, which contains the exposed window wall.

Fallout protection was obtained by filling with mortar the concrete masonry units used in the construction of the community room walls. This significantly increased the density of the walls and provided a vertical barrier against any radiation coming into the basement. The overhead floor slab is thick enough for adequate shielding against roof contribution.

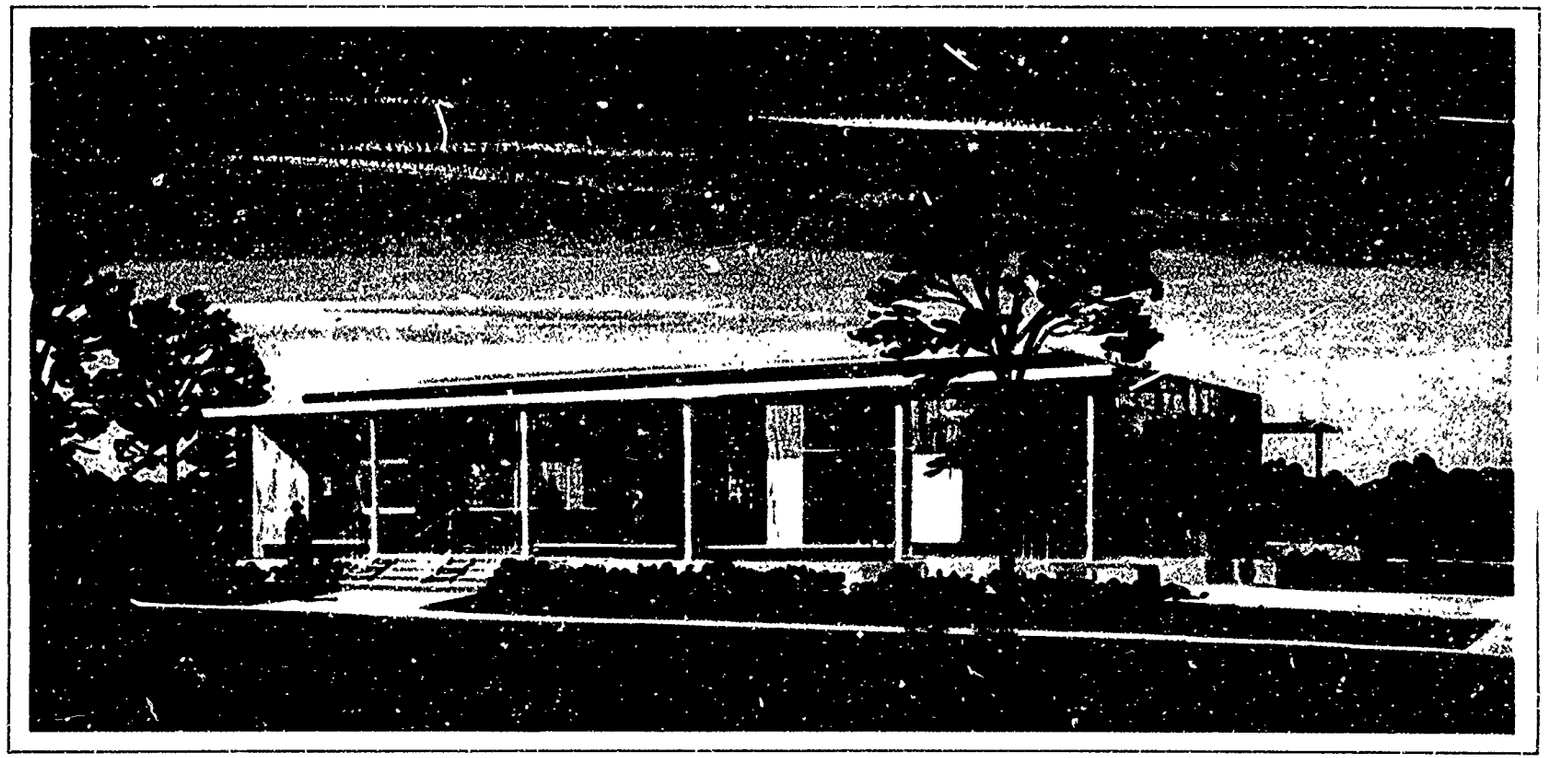
Construction Cost:
$172,000 or $20.80 per sq. ft.
Shelter Area:
1,082 sq. ft.
Shelter Cost:
$2,000 or $0.23 per sq. ft. of building area



Basement Plan



Section



Exterior Perspective

Wyoming National Guard Armory

Wheatland, Wyoming
Corbett, Dehnert, AIA, Architects
Landers, Wyoming
Eugene Dehnert, AIA, Shelter Analyst

When the Armory was in preliminary design, the Adjutant General of the Wyoming National Guard asked the architects to study the feasibility of including fallout protection in the structure. They investigated the possibility of providing a space to be used solely as a shelter but decided that spaces already included in the design could serve a dual purpose. As a result, the dressing room, shower and meeting room areas were placed belowgrade as a basement. Merely increasing the thickness of the concrete floor slab over these areas provided fallout protection.

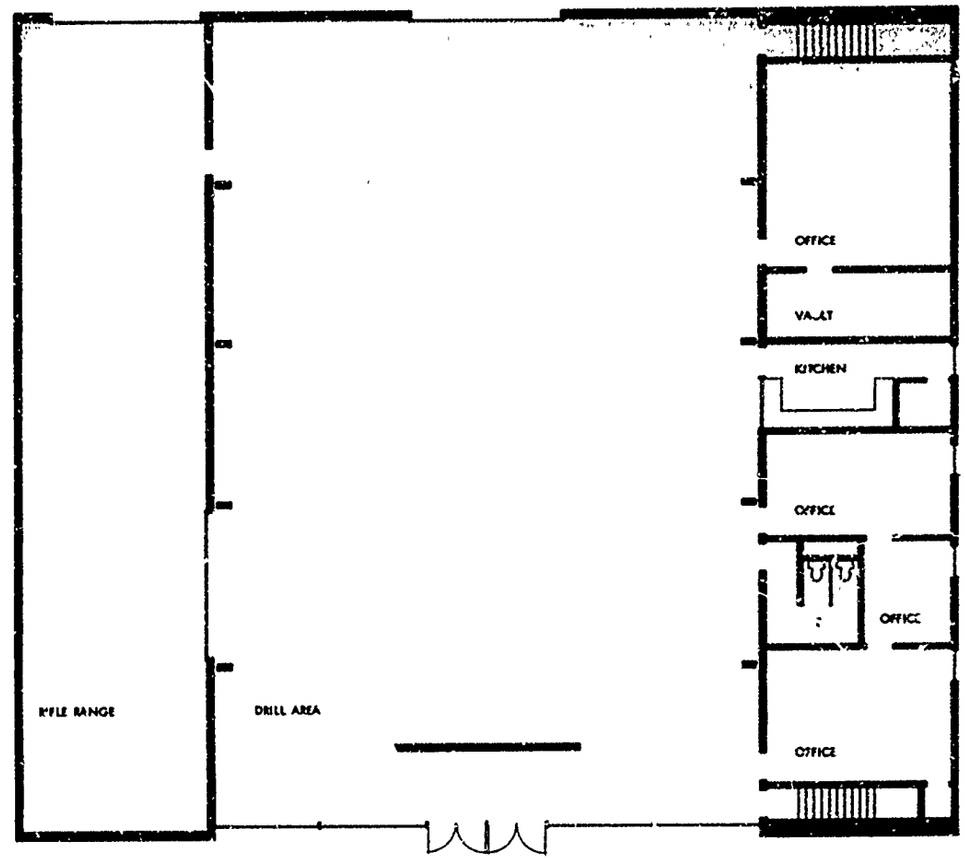
The building utilizes laminated-wood rigid frames. The exterior walls of structural clay tile are filled with vermiculite insulation. A forced-air heating system is utilized for ventilation. Two water storage tanks and an amergency generator are provided for use by shelter occupants.

In a nuclear emergency, this shelter could serve as a command center for the National Guard in the region. The shelter has a capacity of 150 with a protection factor in excess of 1,000.

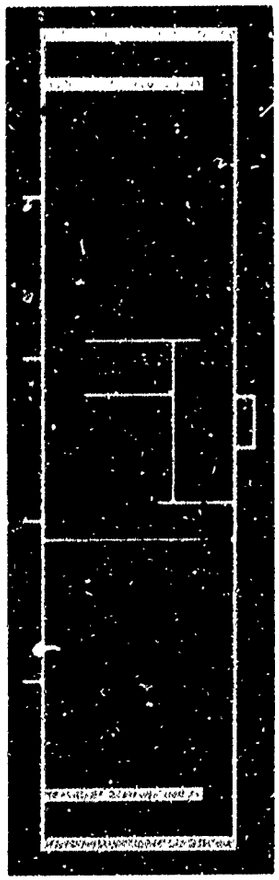
Construction Cost:
$152,850 or $13.54 per sq. ft.

Shelter Area:
1,960 sq. ft.

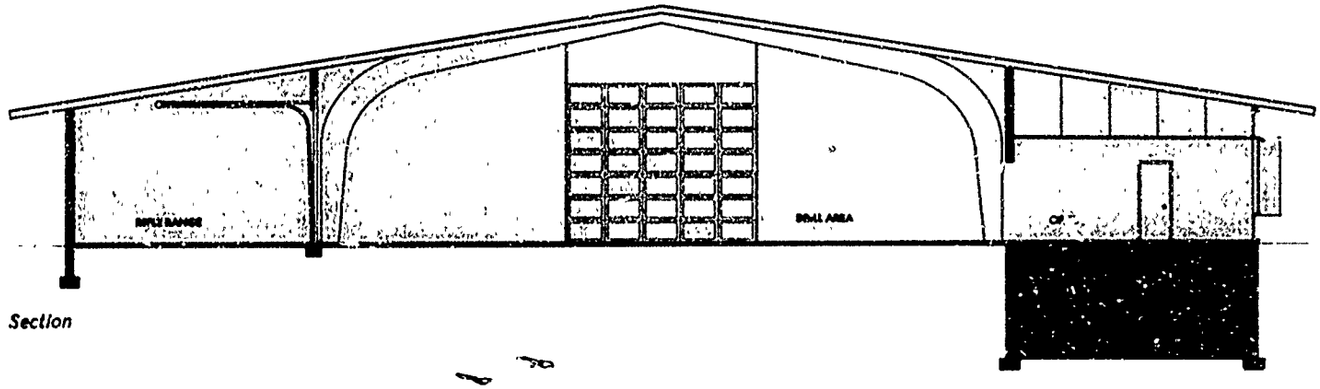
Shelter Cost:
General Construction: $5,375 or $0.48 per sq. ft. of building area
Plumbing and Electrical: $3,550



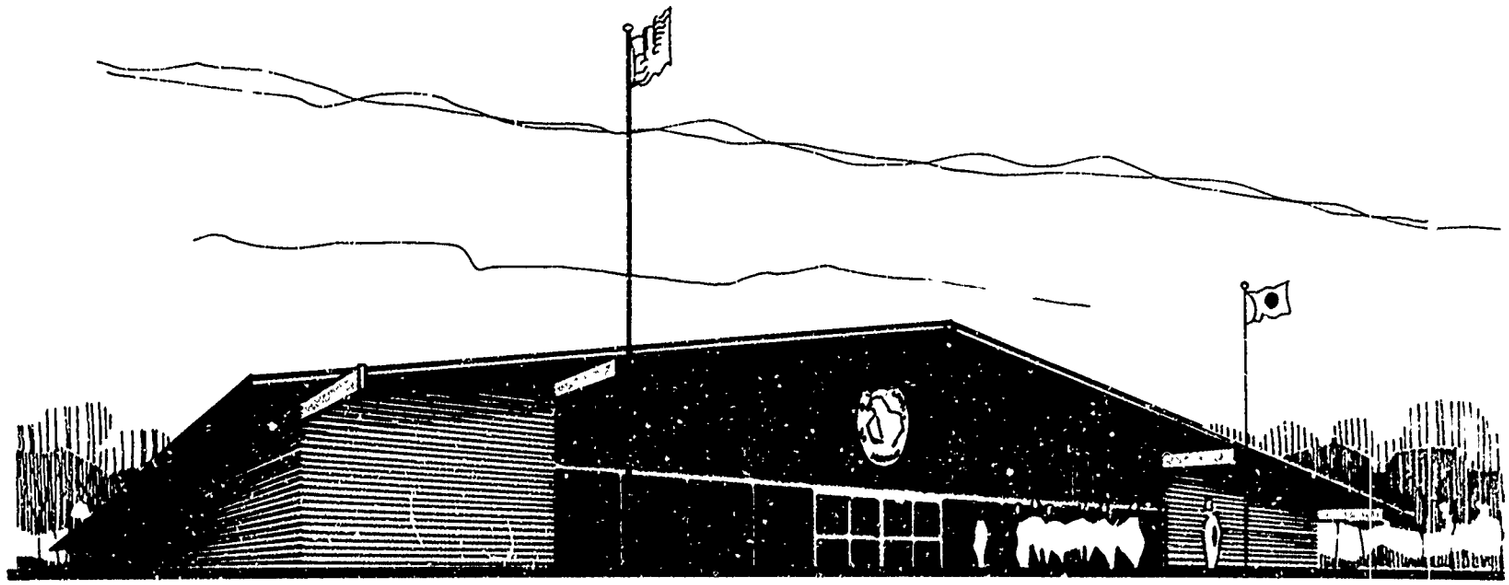
Floor Plan



Basement Plan



Section



Exterior Perspective

City Hall Building Addition

Brookfield, Wisconsin
Shutte, Phillips, Mochon, AIA
Architects and Engineers
Milwaukee, Wisconsin
Lloyd L. Kessler, Shelter Analyst
New Berlin, Wisconsin

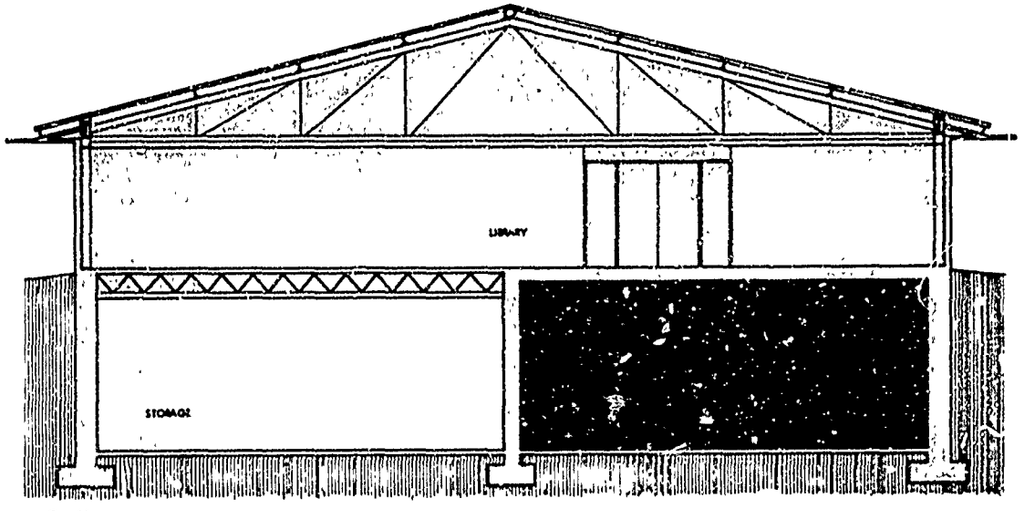
The recent addition to this City Hall building is part of a master plan to develop a Civic Center for the city of Brookfield, Wisconsin. The Civic Center is designed to be constructed in stages, with the cost spread over a 20-year period through bond issues.

The first unit constructed was the City Hall. An addition became necessary because of the lack of sufficient space to carry on the functions of city government effectively, and was designed to relate functionally to the existing original structure, yet conceal it and create a contemporary architectural effect.

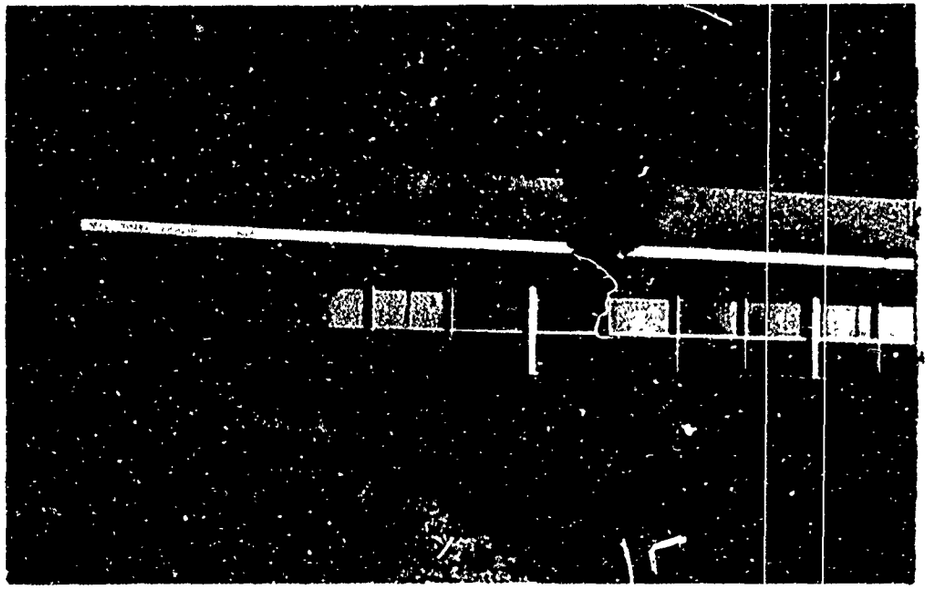
The building is designed on a modular basis to allow movement of partitions on a 5-foot module. This will enable city departments to move and expand as the city population increases and additional office space is required to meet city government requirements.

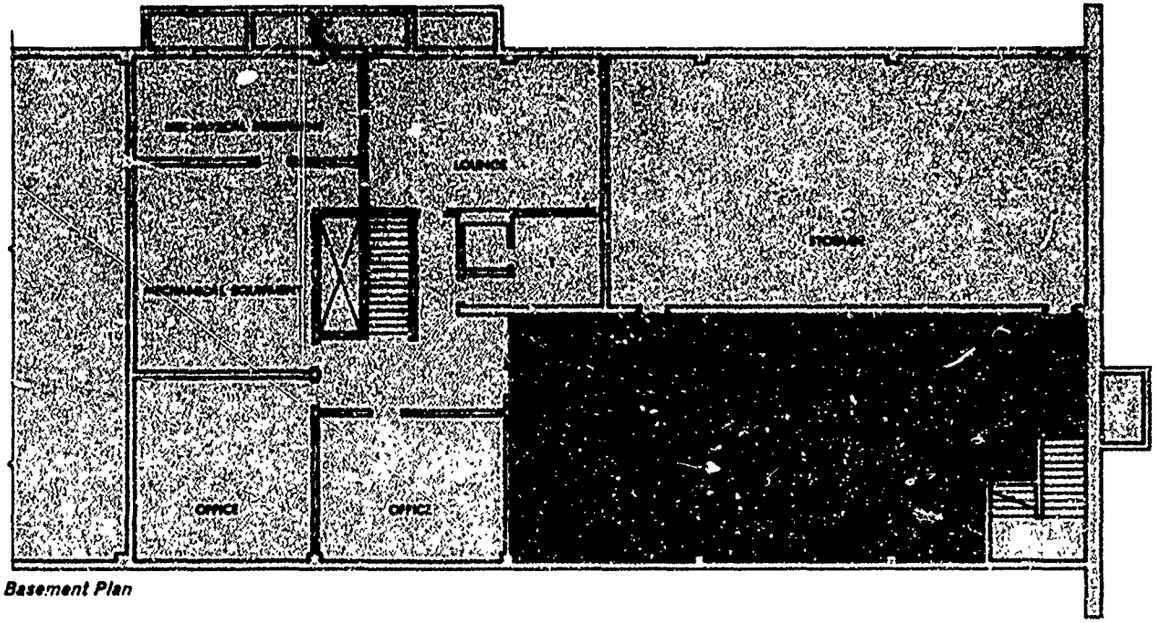
The addition is essentially a two-story structure, with the first story completely belowgrade. Shelter for 140 persons is available in a storage area and corridor in the basement.

Construction Cost:
$153,804 or $12.30 per sq. ft.
Shelter Area:
1,485 sq. ft.
Shelter Cost:
$300 or $0.02 per sq. ft. of building area

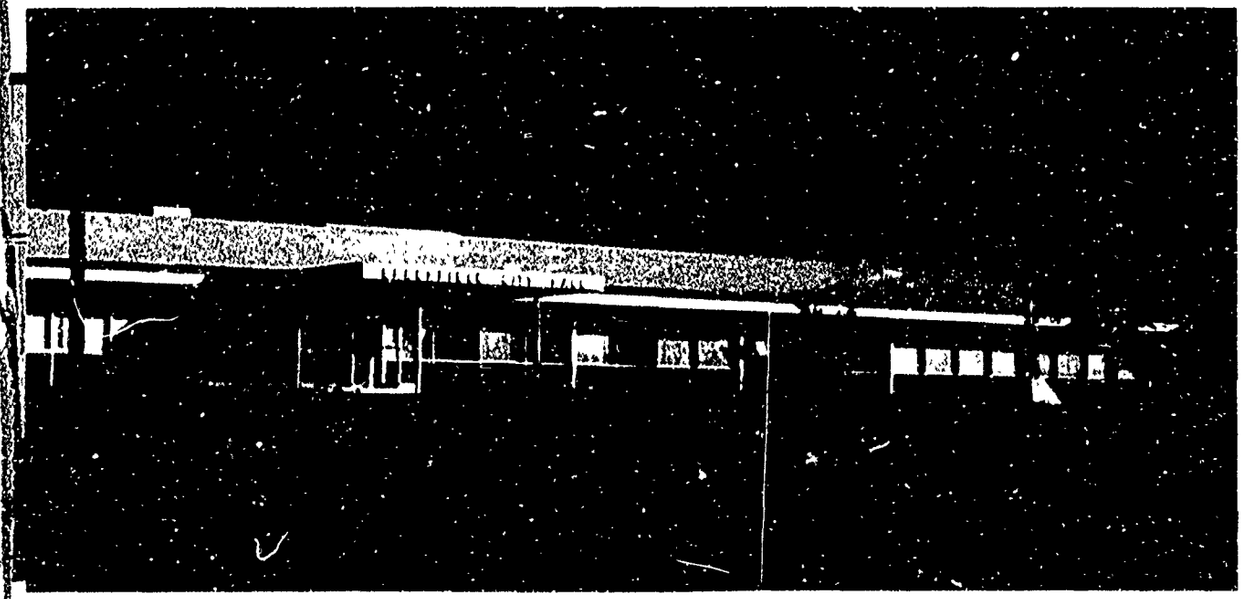


Section





Basement Plan



Student Union Building
Mississippi State University

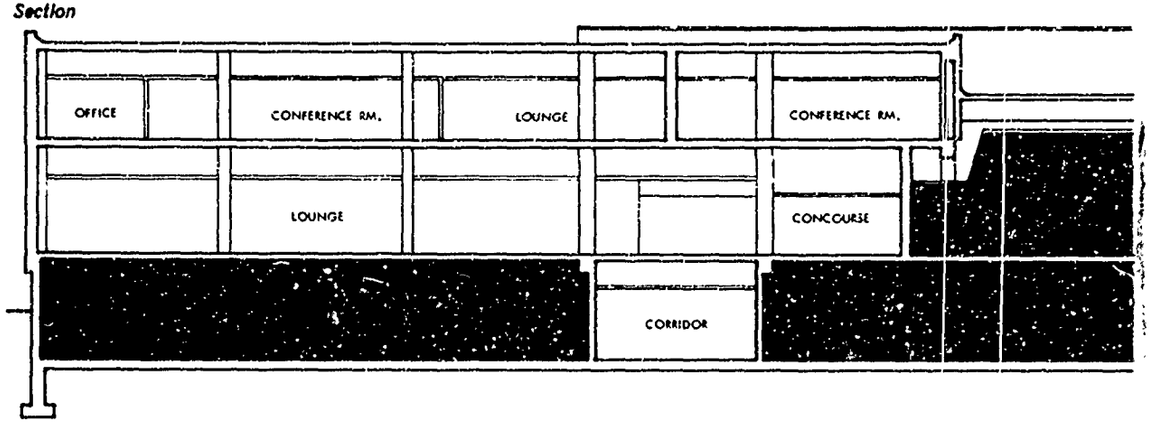
State College, Mississippi
Thomas H. Johnston, Jr. & Associates, AIA
Architects-Engineers
Starkville, Mississippi

The Student Union Building is essentially a three-story reinforced-concrete structure, with the first story partially belowgrade. The building houses such student facilities as bookstore, snack bar, lounge, and recreation areas. It is completely air-conditioned and windows have been minimized.

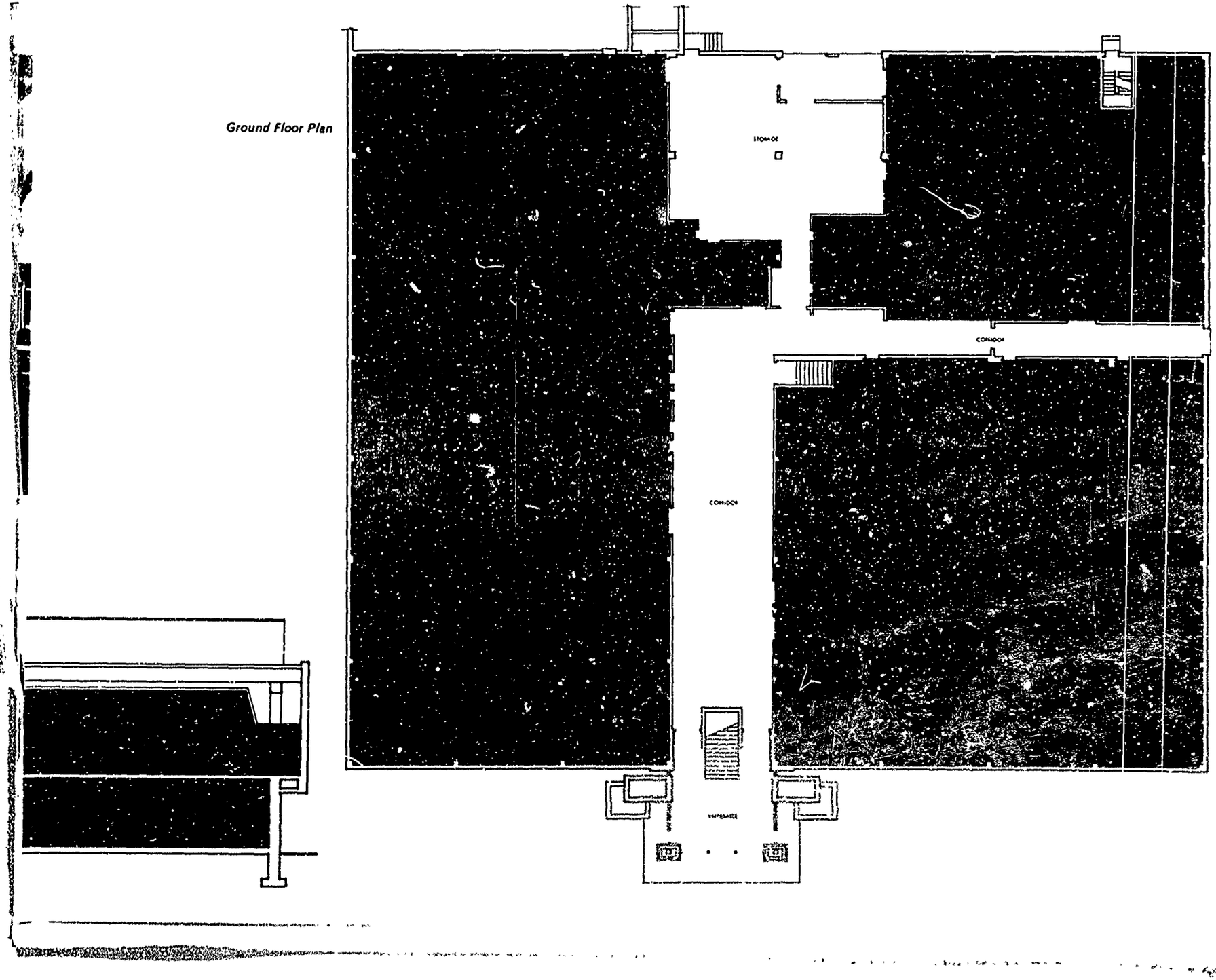
Fallout protection has been incorporated into most of the ground floor and some portions of the first floor. This was attained through use of 6-inch concrete floor slabs and exterior walls of clay tile, concrete masonry units and face brick. Another contributing factor is the site topography, which permitted the building to be recessed into the ground and still provide at-grade entrance-ways on the first floor as well as the ground floor.

Construction Cost:
$1,890,000 or $18.75 per sq. ft.
Shelter Area:
40,000 sq. ft.
Shelter Cost:
None—inherent in basic design

Section



Ground Floor Plan



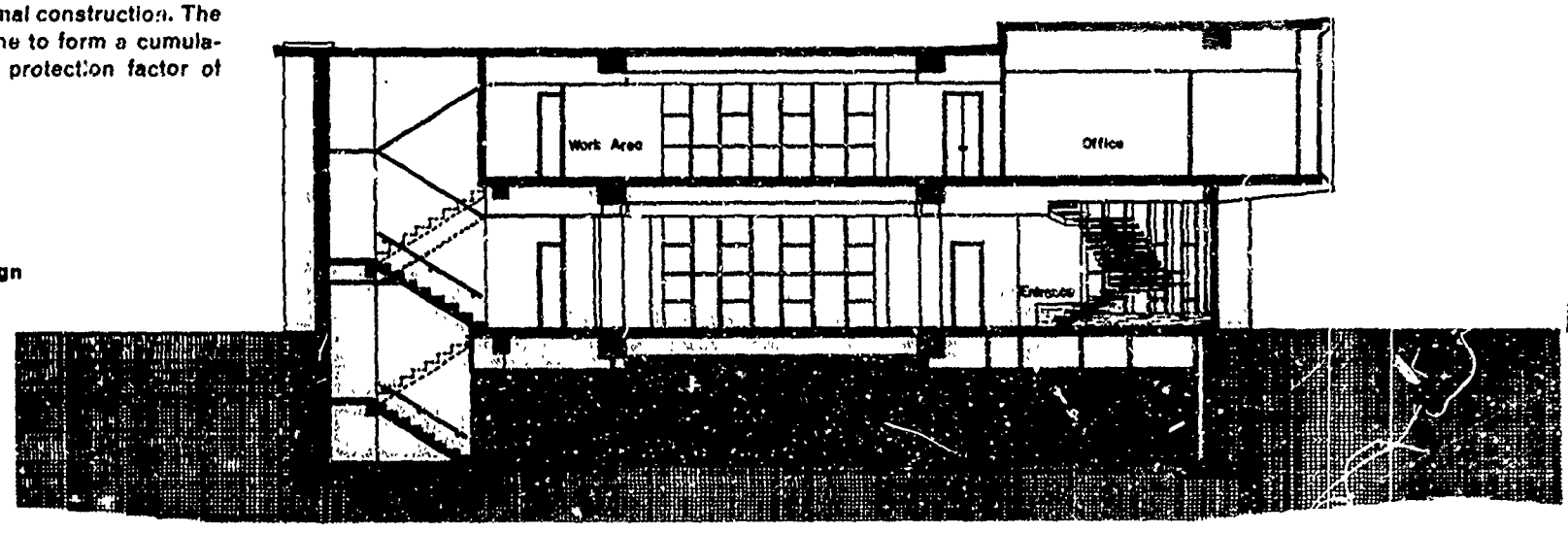
First Federal Savings and Loan Association

Shreveport, Louisiana
Jos. P. Schierer, AIA, Architect
Shreveport, Louisiana

The First Federal Savings and Loan Association Building of Shreveport is a circular two-story building with a basement area. Banking and loan services are provided at the ground-floor level. Service areas are on the second-floor and basement levels. Meeting rooms, offices and staff lounge are situated at the basement level, and these areas also serve as fallout shelter.

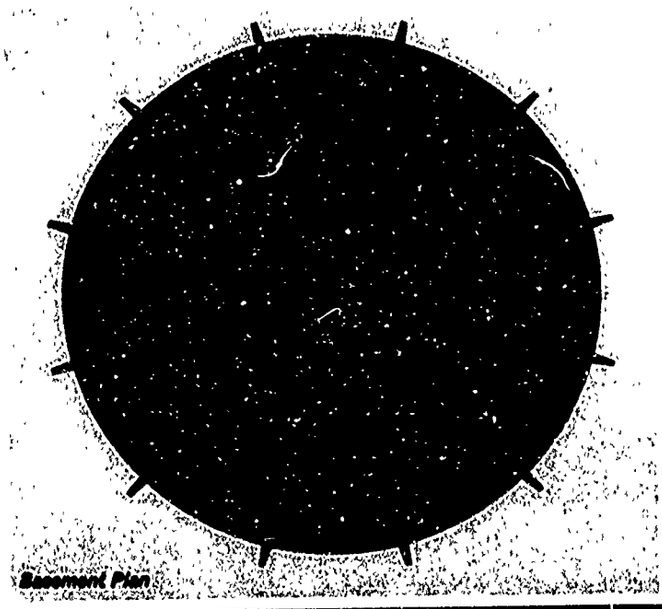
Shelter space was provided as an inherent part of the construction at no increase in cost to the project. The architect utilized 6-inch thick concrete floor slabs as part of the normal construction. The three overhead slabs combine to form a cumulative barrier that provides a protection factor of 1,000 in the shelter area.

Construction Cost:
$283,727 or $24.60 per sq. ft.
Shelter Area:
2,722 sq. ft.
Shelter Cost:
None—inherent in basic design

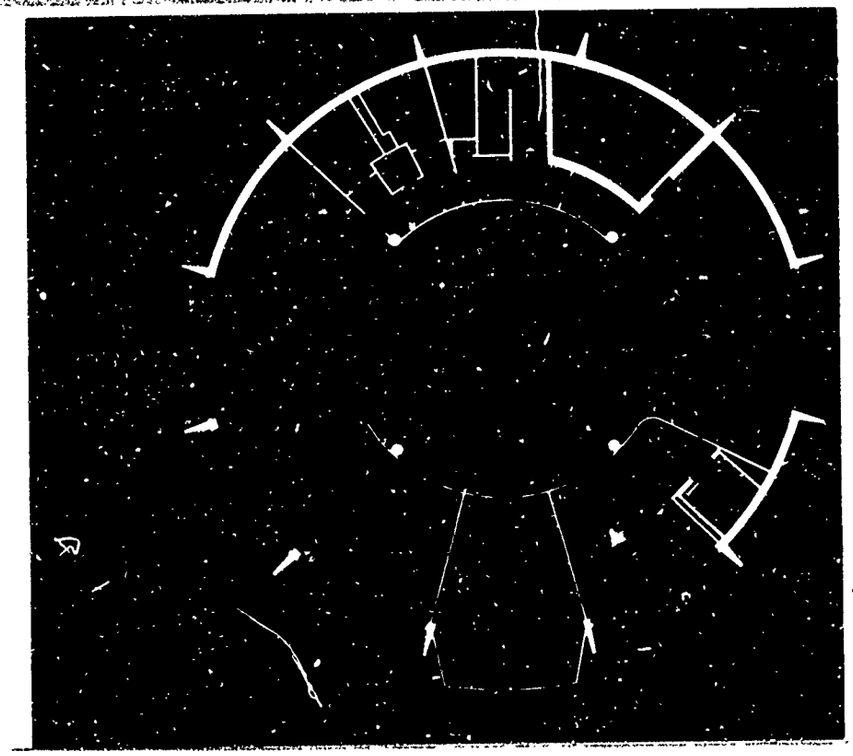


Section

Section

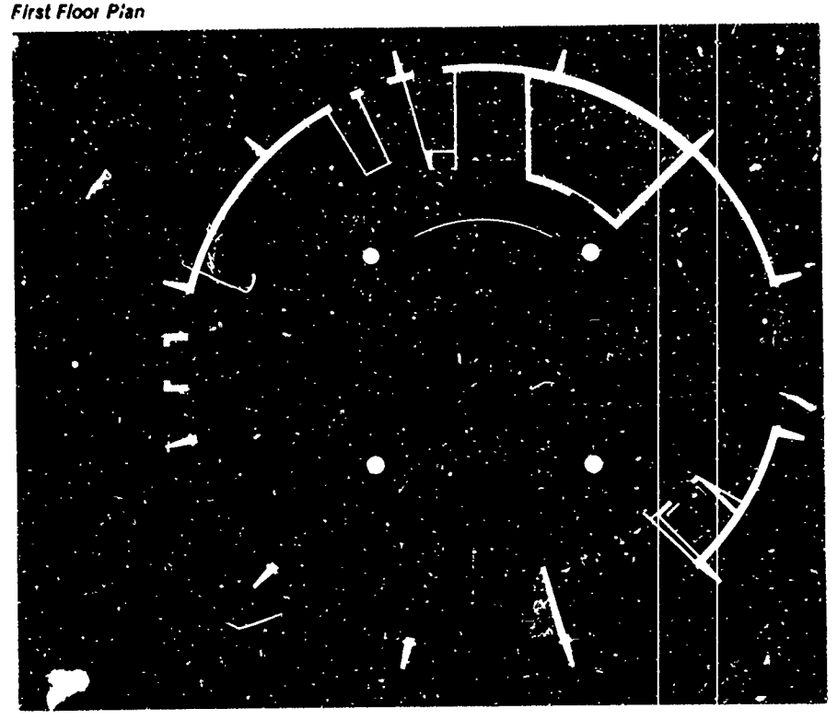


Basement Plan



Second Floor Plan

First Floor Plan



Dade County Teachers' Federal Credit Union

Coral Gables, Florida
Watson, Deutschman and Kruse, AIA
Architects and Engineers
Miami, Florida
M. W. Deutschman, PE, Shelter Analyst

The building is a three-story reinforced-concrete structure, above an open, partially belowgrade parking level. Decorative umbrellas, actually part of the structural frame, project from the front and rear of the building. These umbrellas function as sun screens in addition to their visual effect.

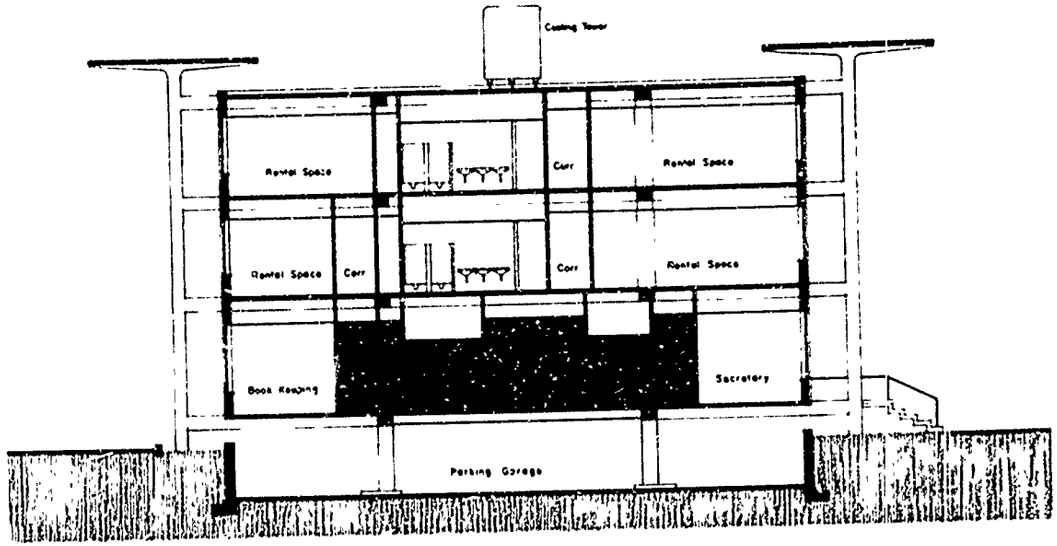
The credit union offices are located on the first floor. The upper floors are leased as office space. The building is air-conditioned except for the parking level.

Shelter, which was a part of the building design, is located in the two concrete vault areas in the center of the first-floor level and the corridors surrounding the vault area. The vaults have been interconnected and linked to kitchen and toilet facilities normally used by the employees of the credit union.

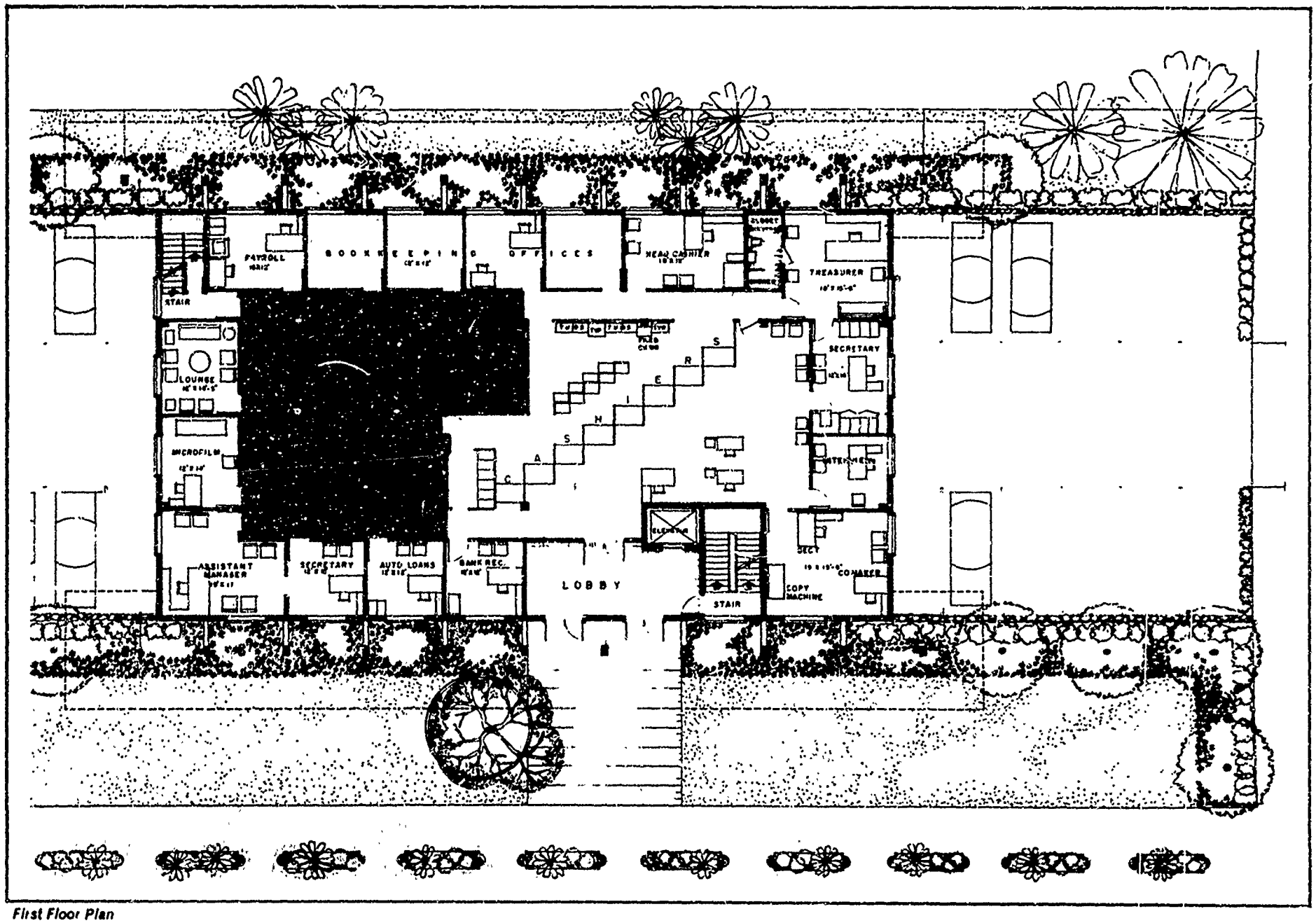
Construction Cost:
$411,038 or $19.04 per sq. ft.

Shelter Area:
750 sq. ft.

Shelter Cost:
None—inherent in basic design



Section



First Floor Plan

Lenihan High School

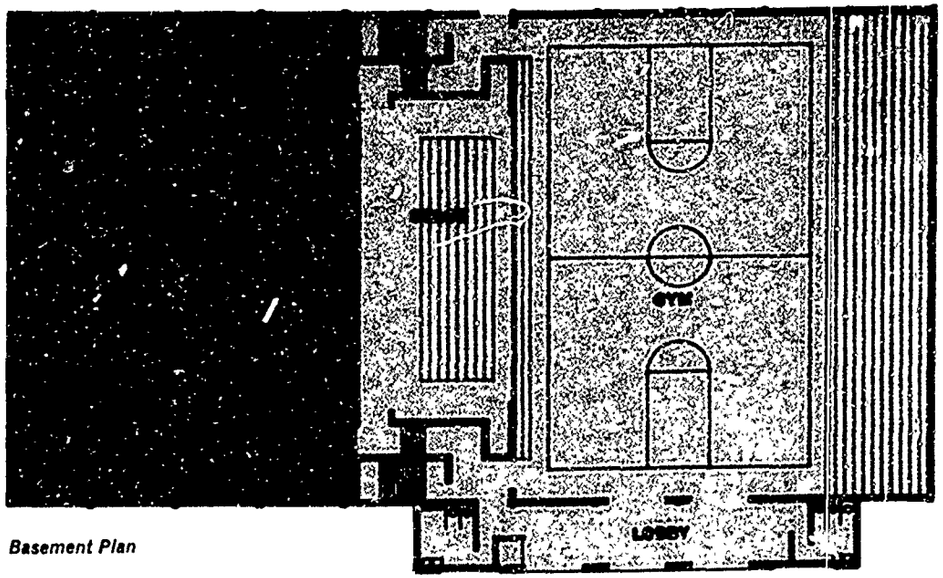
Marshalltown, Iowa
Donald P. McGinn Associates, AIA
Architects
Dubuque, Iowa
Donald P. McGinn, Shelter Analyst

The Lenihan High School is a Catholic school with an academic program equivalent to that of a four-year general high school. The design of the school calls for four "houses" to contain classrooms, laboratory space, conference rooms, and rest rooms. Only three "houses" have been constructed to accommodate a projected student enrollment of 300. The fourth unit will be added at a future date to accommodate an ultimate school enrollment of 500 students.

Corridors connecting the air-conditioned "houses" border on an exterior courtyard, providing a pleasant view for the student moving from one area to another within the building. Centrally located between the "houses" are the library, chapel and administrative offices.

The noise-producing activities, such as the gymnasium, cafeteria, and music department, are separated from the classroom units by a landscaped courtyard. The music department is located beneath the cafeteria, at the same level as the stage in the gymnasium. The oval-shaped music room, with permanent concrete steps ascending from the center, provides space for choral and band rehearsal, speech and debate arena and a theater-in-the-round.

The architect was able to provide built-in fallout protection in this general-purpose room. The protection factor is in excess of 50, and shelter capacity is 600 persons. Protection was attained by increasing the thickness of the reinforced-concrete floor of the cafeteria, directly over the music room.



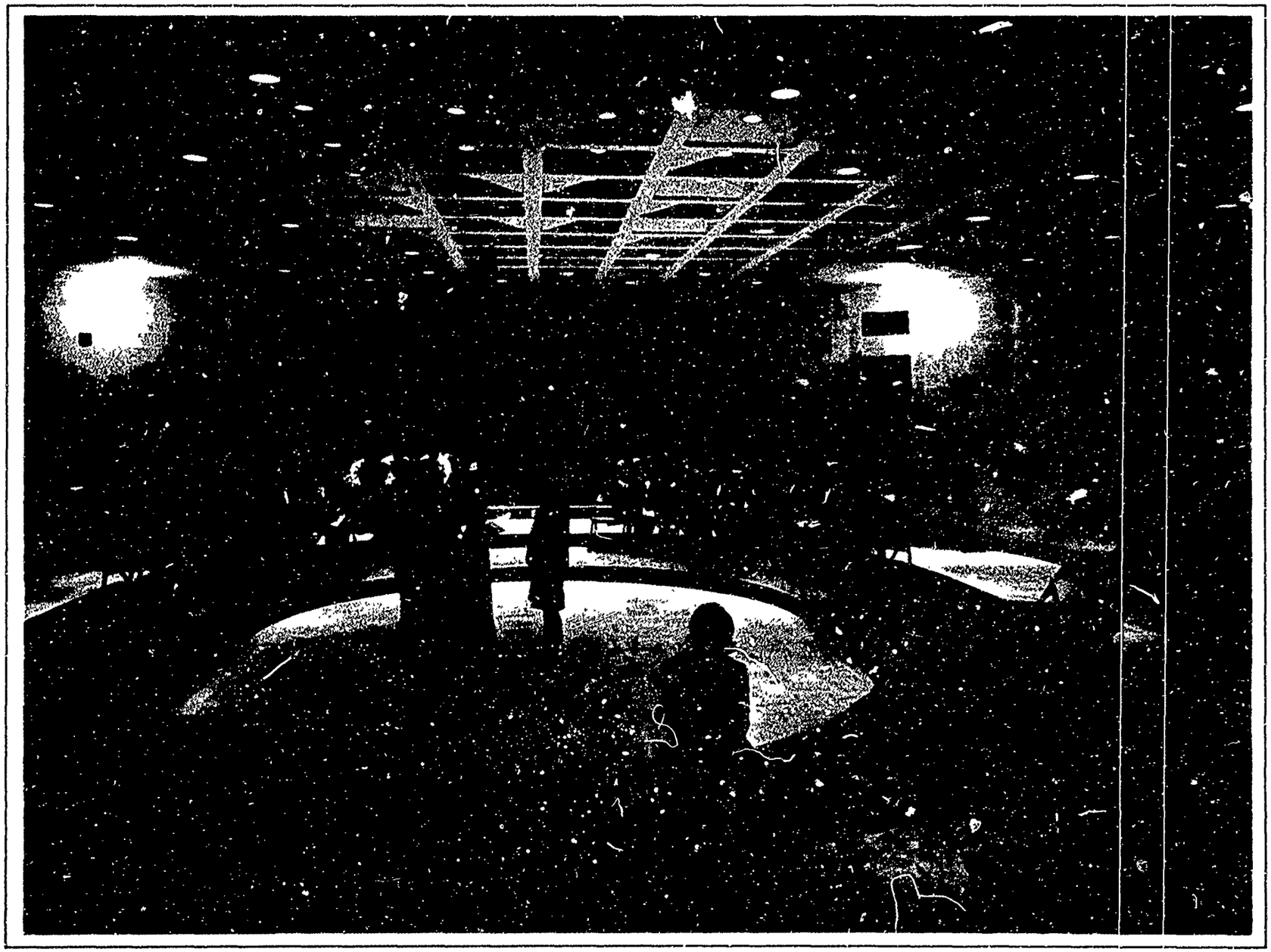
Basement Plan

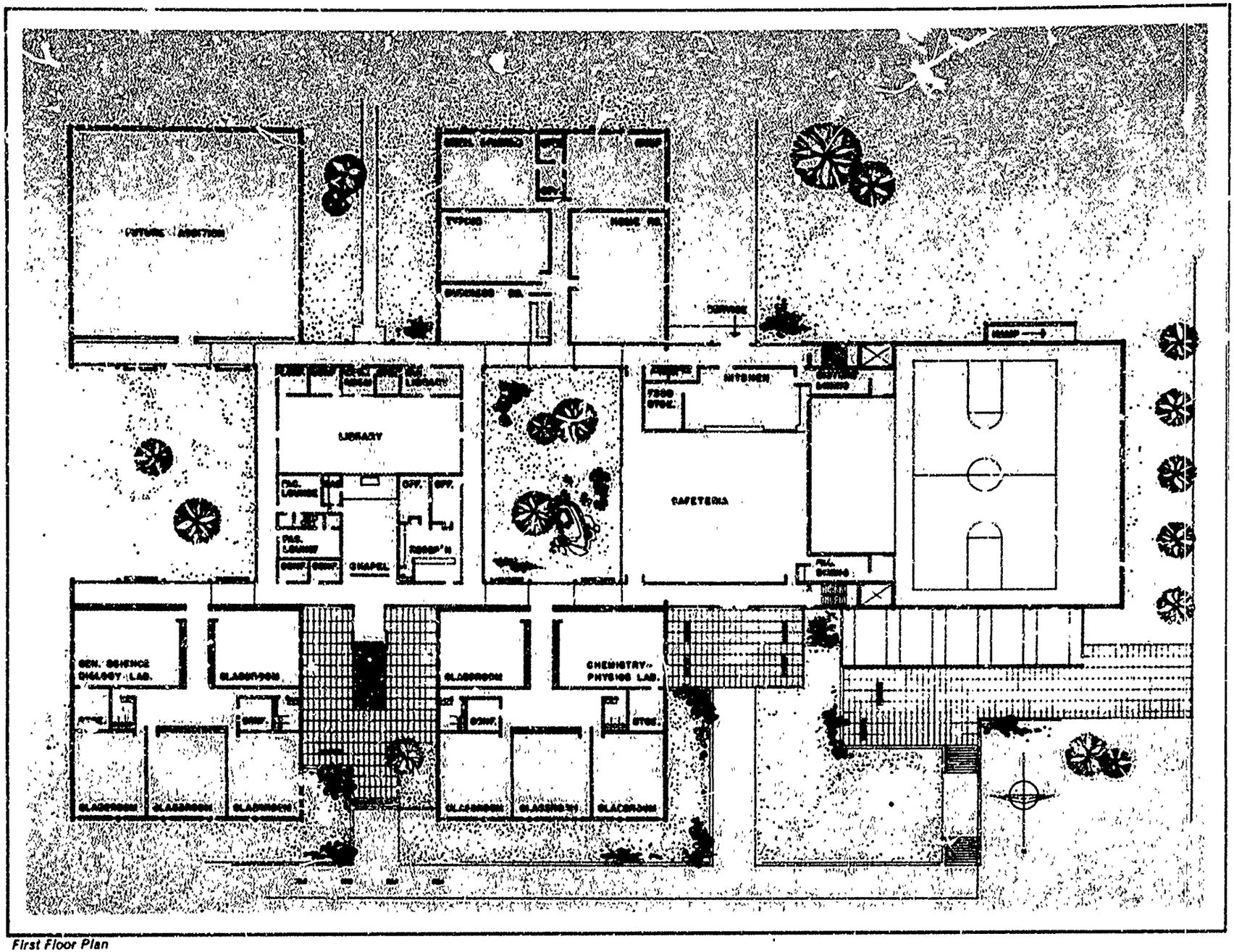
The floor elevations of the units follow the natural slope of the site. Changes in floor elevation between units are achieved by corridor ramps. The gymnasium is located at the low portion of the site most convenient to the parking lot. The design is such that a continuous roof line is maintained over the gymnasium, stage, cafeteria and classroom areas.

Construction Cost:
$775,000 or $12.79 per sq. ft.
Shelter Area:
7,000 sq. ft.
Shelter Cost:
$3,250 or $0.05 per sq. ft. of building area

The architect was able to provide built-in fallout protection in this general-purpose room. The protection factor is in excess of 50, and shelter capacity is 600 persons. Protection was attained

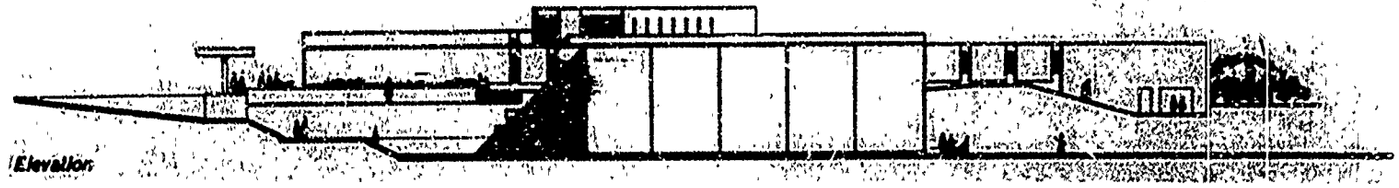
Shelter Area:
7,000 sq. ft.
Shelter Cost:
$3,250 or $0.05 per sq. ft. of building area



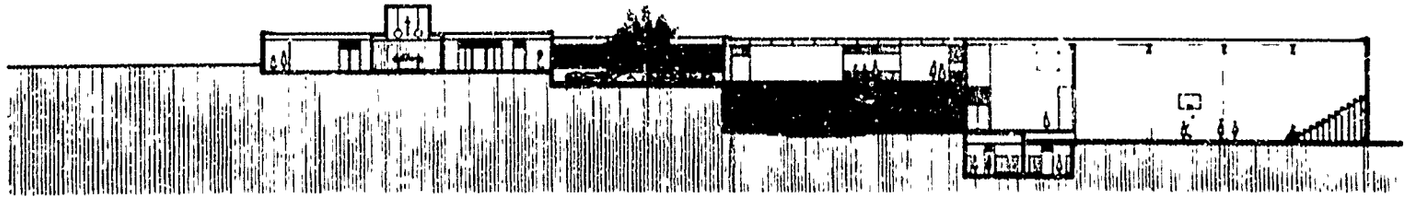


First Floor Plan

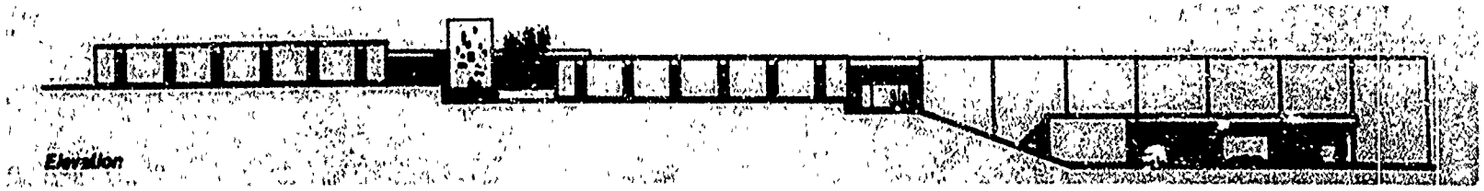
First Floor Plan



Elevation



Section



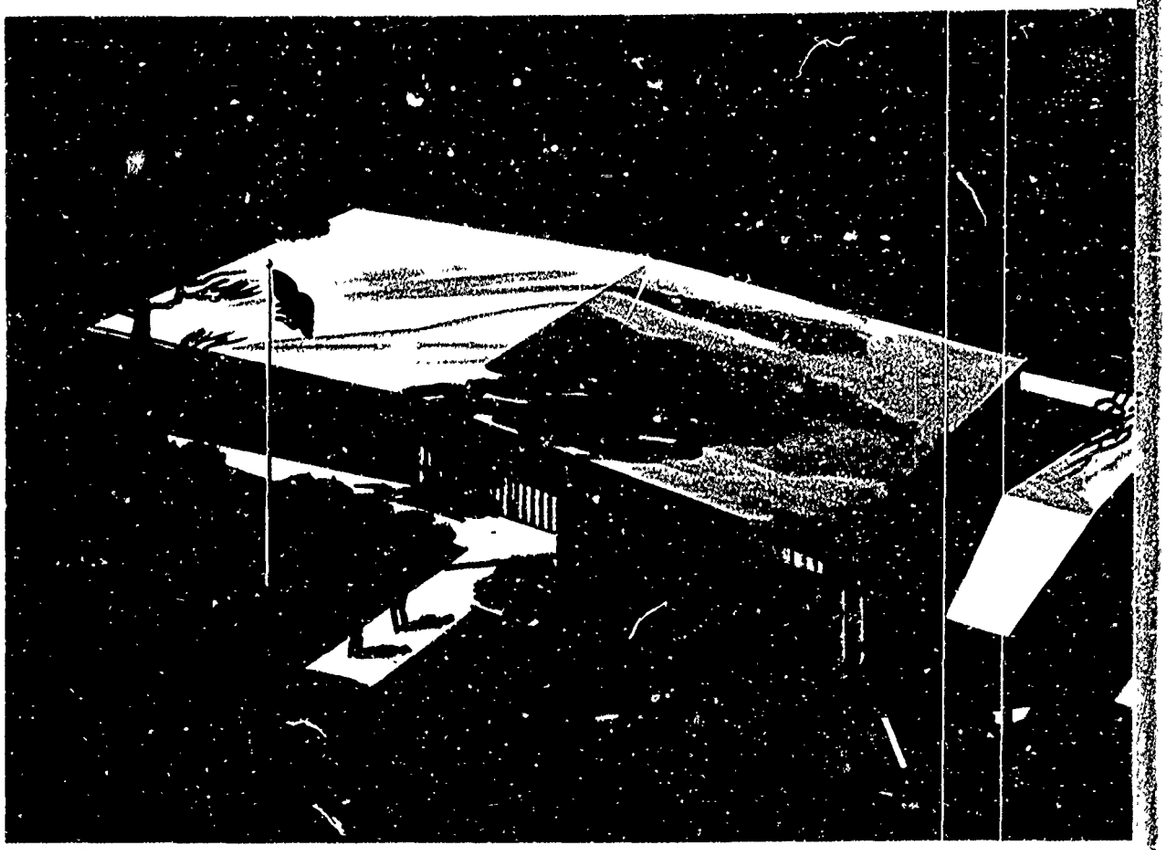
Elevation

Kenton Ranger Station
U. S. Forest Service

Ottawa National Forest
Kenton, Michigan
Carl Sandine, U. S. Forest Service, Architect
Milwaukee, Wisconsin
D. C. Turner, Shelter Analyst
Milwaukee, Wisconsin

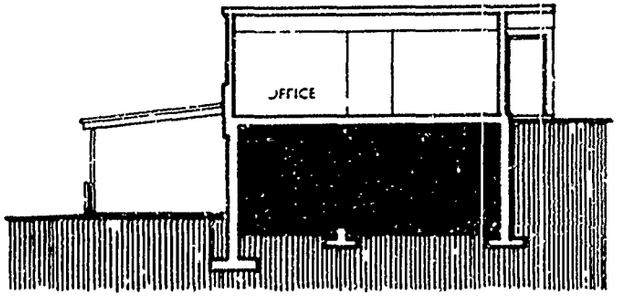
The U. S. Forest Service is responsible for the protection, development and use of natural resources of the Federally owned land comprising the various forest districts. In accomplishing its mission, the Service recently designed and constructed the Kenton Ranger Station and incorporated fallout protection into the structure. It is a small two-story building used by the district ranger and his personnel in administering activities within the Ottawa National Forest. The building is the active center for recreation, hunting, fishing, visitor information and forestry activities.

The ranger station is located on a sloping site that permits at-grade entry on both floors. The lower floor contains office and storage space. Fallout shelter for 105 persons in the storage area on the lower floor was obtained by placing sand in the voids of the hollow-block exterior wall and using a 4-inch brick veneer. Overhead shielding of the shelter area was provided by using an 8-inch precast-concrete plank floor system with a 3-inch concrete topping. A 12-inch block wall behind the reception room serves as a barrier to the shelter corridor for any radiation that might enter through the office windows and light weight exterior office walls.

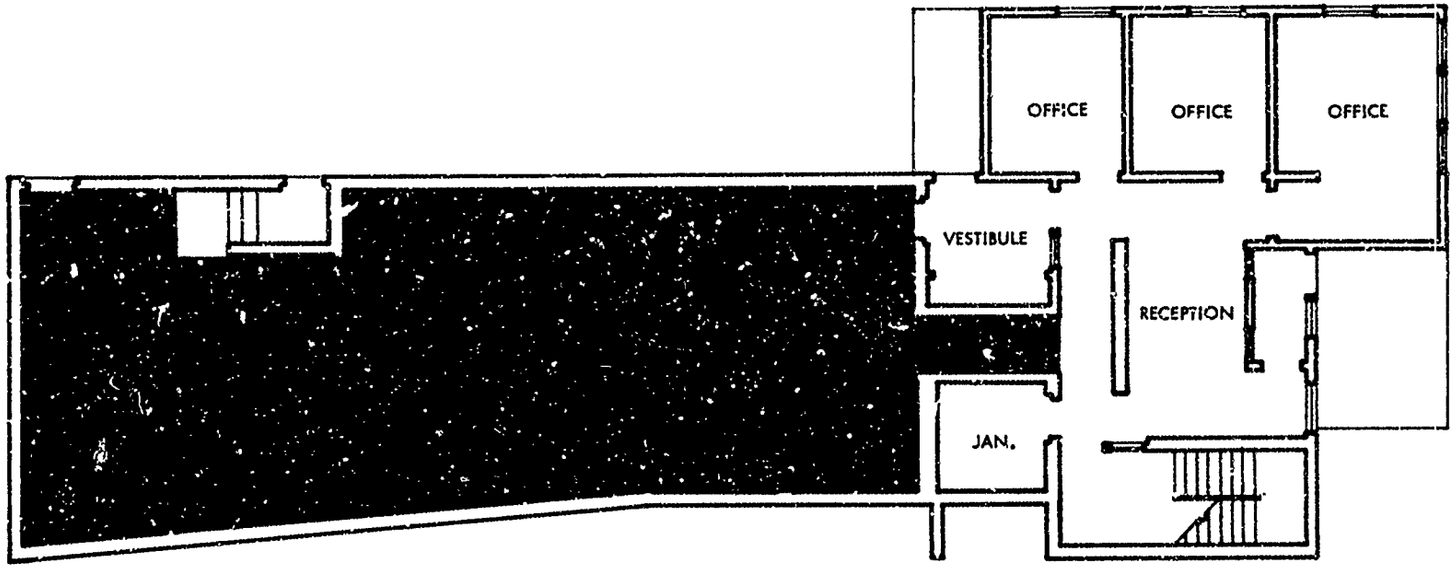


Exterior Perspective

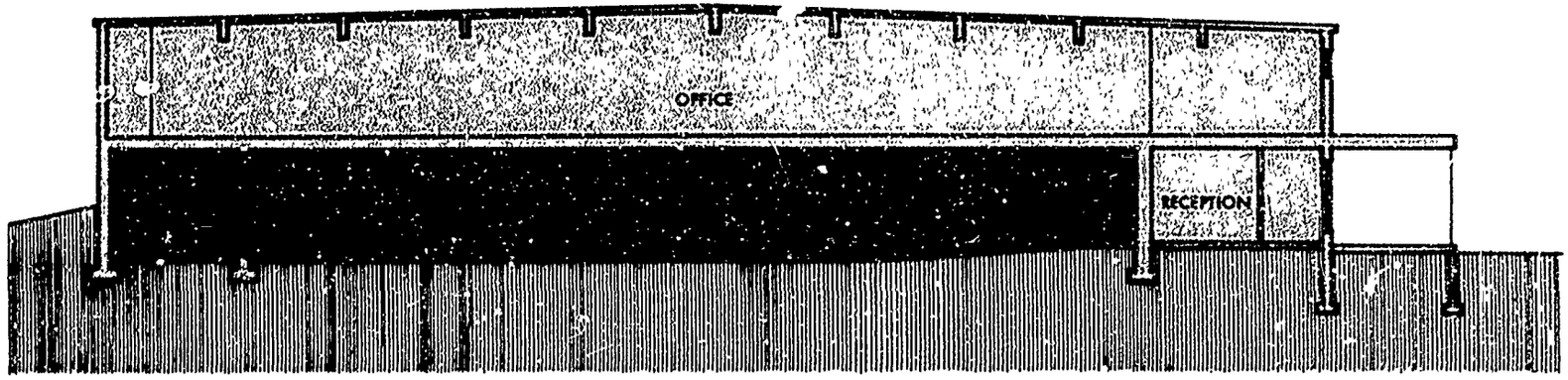
Construction Cost:
$94,706 or $16.40 per sq. ft.
Shelter Area:
1,580 sq. ft.
Shelter Cost:
$625 or $0.11 per sq. ft. of building area



Section



Ground Floor Plan



Section

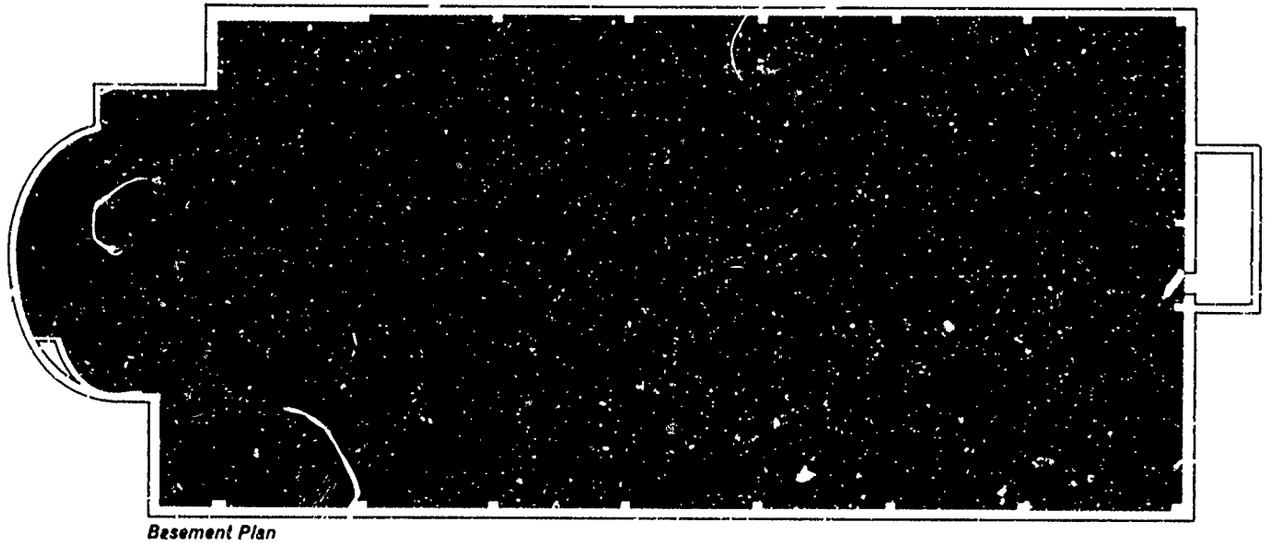
Central Library Building
Lansing School District

Lansing, Michigan
Kenneth C. Black Associates, AIA, Architects
Lansing, Michigan
William D. Black, Shelter Analyst
Lansing, Michigan

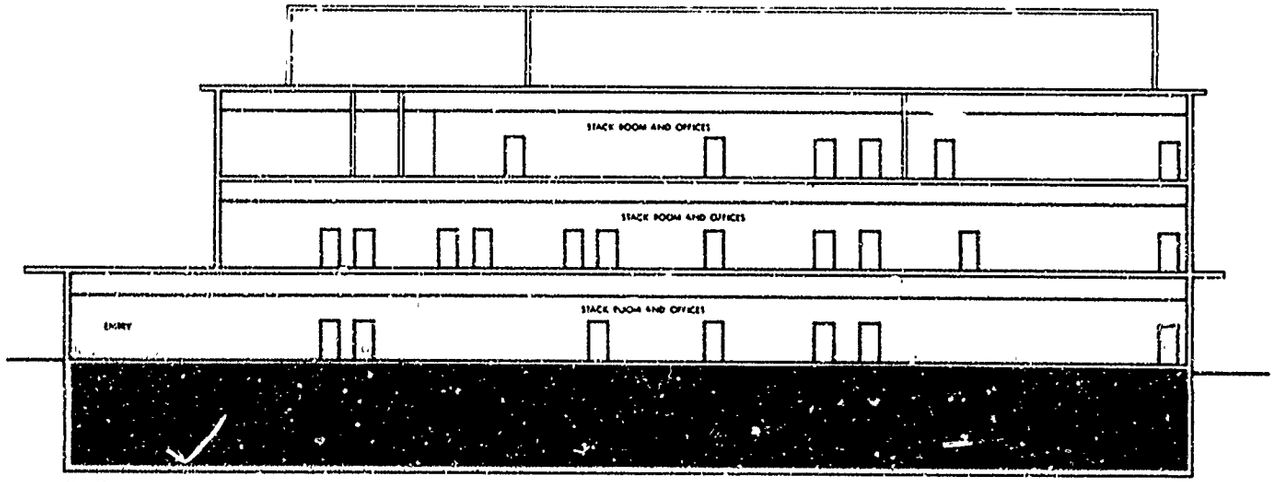
This building is the central library facility for all the school and public branch libraries within the Lansing School District. Historical and special book collections, special services, book storage and general book circulation are the major functions within the facility.

The building essentially contains five levels, with the basement and mezzanine levels belowgrade. Fallout protection for 1,760 persons is located predominantly at these belowgrade levels. The protection afforded ranges from PF 500 to PF 3,800 at the basement level. This high degree of protection is a direct result of the normal concrete floor construction, which cumulatively provides an effective overhead barrier to any radiation emanating from fallout particles that might accumulate on the roof. It was not necessary to add to any of the existing building components to provide this shielding.

Construction Cost:
$1,394,000 or $27.50 per sq. ft.
Shelter Area
17,000 sq. ft.
Shelter Cost:
None—inherent in basic design



Basement Plan



Section

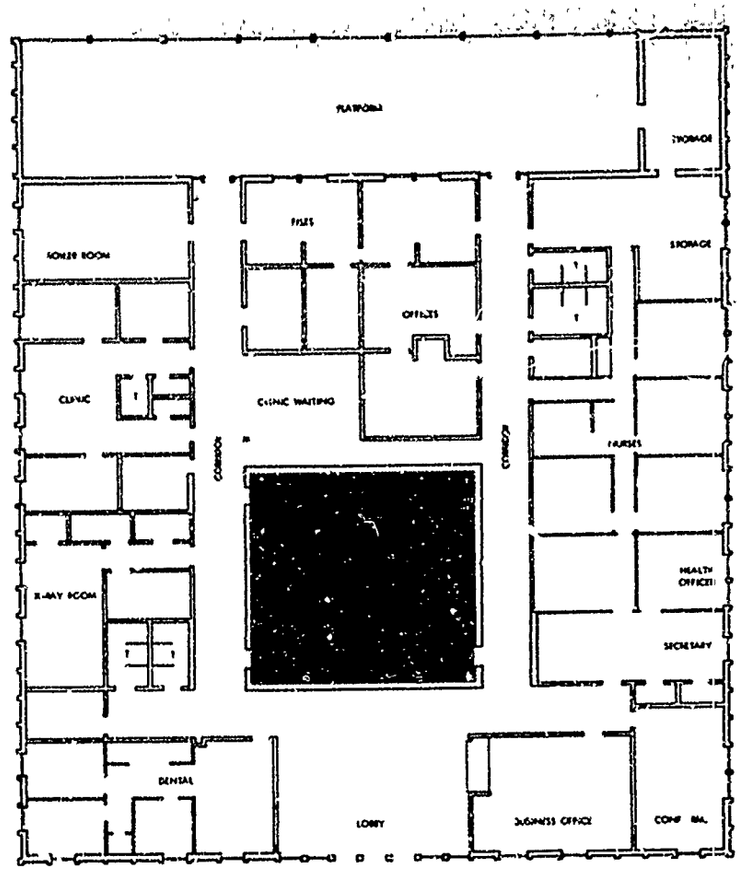
Health Center
Tri-County Health Department

Cairo, Illinois
Lee Potter Smith & Associates
of Carbondale, AIA
Architects
Carbondale, Illinois
Marion L. Wills, Shelter Analyst
Carbondale, Illinois

This recently constructed Health Center is an example of providing economical fallout protection in the most difficult type of building—a one-story, aboveground structure. The building houses the staff of the Tri-County Health Department and serves the residents of Alexander, Pulaski and Union County, Illinois.

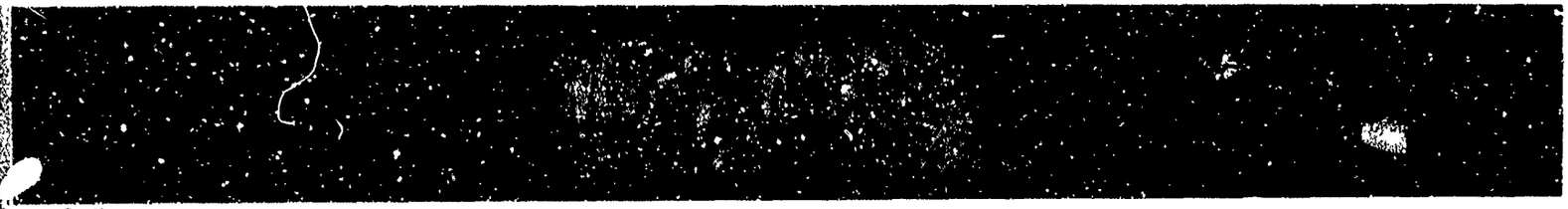
During the preliminary design phase of this building, the members of the Health Center Board felt it would be advantageous and desirable to incorporate fallout protection in the design of the structure. This was accomplished by providing a central core area surrounded by nurse's offices, dental offices and other clinical office areas, all on one floor level. There is no basement in the building.

Fallout shelter for approximately 80 persons is located in the classroom, kitchen and projection booth areas in the central core of the building. A protection factor in excess of 100 was obtained by using 12-inch reinforced concrete walls and roof surrounding and over the classroom facility instead of normal construction. An emergency generator has been made available as an alternate power source should a power failure occur.



Floor Plan

Construction Cost:
$225,000 or $18.75 per sq. ft.
Shelter Area:
1,093 sq. ft.
Shelter Cost:
General Construction: $6,200 or $0.52 per sq. ft. of building area
Mechanical and Electrical: $2,400



Section

Exterior Perspective

SHIELDING TECHNIQUES

It is clear that existing facilities will not yield enough shelter space to provide fallout protection for all Americans in the event of a nuclear attack. Therefore, the Office of Civil Defense is placing special emphasis on the incorporation of preplanned, dual-purpose shelter areas in the original design of new structures.

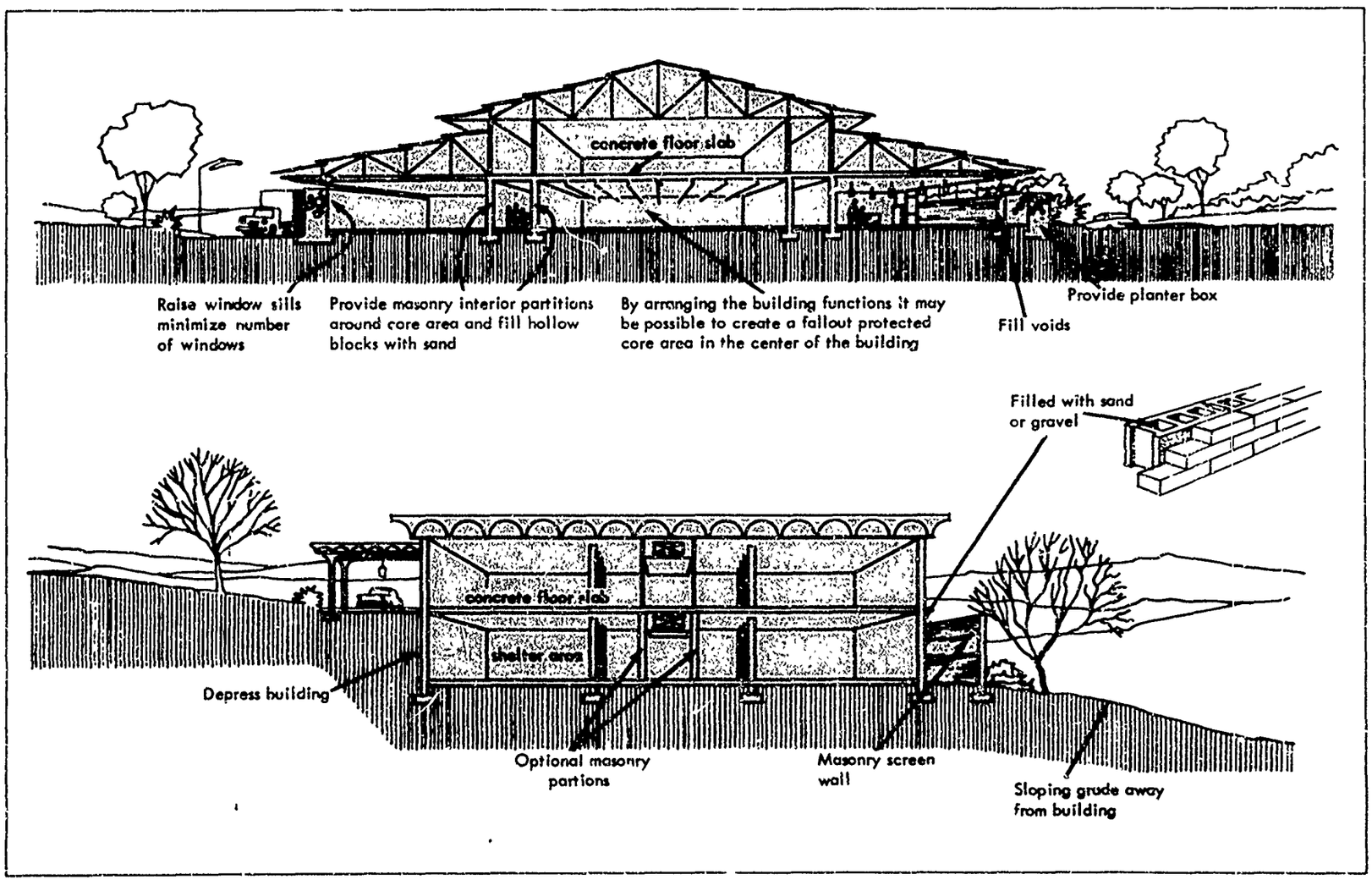
More and more architects and engineers are becoming conscious of the need for fallout protection, and they are now designing new buildings so as to enhance the inherent protection provided without impairing either function or appearance.

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 to provide better shelter for the building occupants. Air conditioning, insulated walls and ceilings, electric lighting, fire extinguishers, firewalls and fire doors are all commonly accepted in current building design.

Every building, to some extent, provides a natural shield against fallout radiation; however, some 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 that nullified otherwise good protection. If these weak points could have been detected by someone knowledgeable in radiation shielding during the initial design phase, then design changes could have been made that would have maximized the fallout protection at little, if any, increase in cost. The incorporation of these shielding techniques to provide fallout protection is called "slanting."

Examples of slanting are: reducing window areas and raising sill heights; judicious use of retaining walls and planter boxes; greding the slope of the ground away from the building; partially depressing the building into the ground; arranging the building modules to provide a protected core area, using concrete floor systems; and filling hollow concrete masonry block walls with sand, gravel or mortar. These shielding techniques and others are illustrated on the opposite page. The buildings depicted in this booklet have utilized these shielding techniques and many others to provide additional fallout protection.

More than 11,000 of this nation's architects and engineers are now knowledgeable in radiation shielding analysis and design, and are becoming skilled in the use of "slanting" to maximize the fallout protection in their current design projects. They have obtained this information as a result of participating in the OCD-sponsored Fallout Shelter Analysis Courses conducted at various schools and universities throughout the country.

The examples presented in this booklet confirm that inexpensive dual-use fallout protection can be incorporated into buildings without detracting in any way from the beauty or usefulness of the building. In many cases the shelter protection can be incorporated into the building design without any increase in cost of construction.

increase in cost. The incorporation of these shielding techniques to provide fallout protection is called "slanting."