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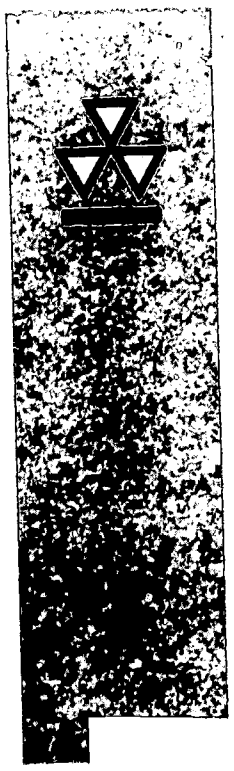
ABSTRACT

Fallout protection can be built into a school building with little or no additional cost, using areas that are in continual use in the normal functioning of the building. A general discussion of the principles of shelter design is given along with photographs, descriptions, drawings, and cost analysis for a number of recently constructed schools incorporating such fallout protection. (JT)



# SCHOOLS BUILT WITH FALLOUT SHELTER

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION



DEPARTMENT OF DEFENSE ■ OFFICE OF CIVIL DEFENSE ■ TR-33 FEB. 1966

# SCHOOLS—DESIGNED WITH FALLOUT SHELTER

The program of the Office of Civil Defense is concentrated on the creation and provisioning of public fallout shelters so that each American will have a place to go should there ever be a nuclear attack on the United States. Millions of shelter spaces have already been located in existing buildings but not nearly enough to satisfy requirements. Additional shelter spaces are needed.

Protection of our school children is of vital concern since approximately one-quarter of the population now attends school for a considerable portion of the day. Many new schools are being built, particularly in suburban areas, where the National Fallout Shelter Survey has indicated a shortage of available shelter space in existing buildings.

The schools included in this booklet illustrate what is now being accomplished by various communities 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. Fallout protection was provided in these buildings without interfering in any way with the primary function of the school. The schools are attractive and contain fallout shelter in above ground as well as below ground locations. The shelter areas are in continuous use as part of the school facility and have been provided without adversely affecting the cost or appearance of the school.

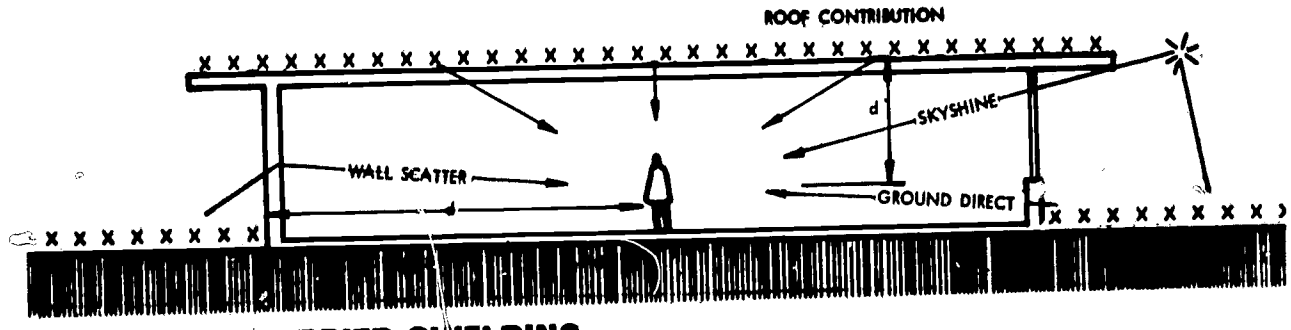
## BASIC CONCEPTS OF PROTECTION

It is common knowledge that a nuclear detonation produces deadly gamma radiation. When it occurs on the ground, it produces widespread fallout of radioactive debris. Less common is an understanding of the harmful effects of gamma radiation from fallout particles and how persons can be protected against them by judicious building design. 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. The concepts that follow are basic to an understanding of the design approach to fallout control.

Gamma radiation reaches an individual in an enclosure from several sources: The *roof contribution* refers to radiation from fallout that may accumulate on an overhead source plane; the *ground contribution* refers to all similar radiation originating from the ground source plane. The ground contribution is further subdivided into ground direct, wall scatter and skyshine.

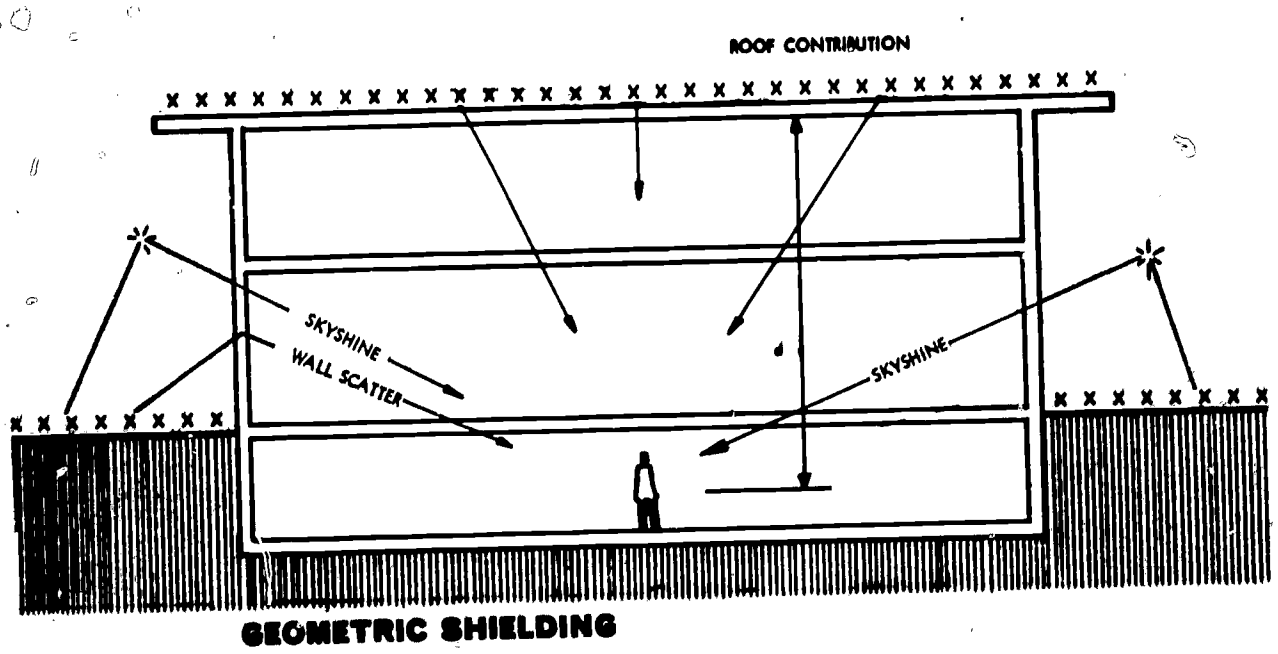
*Protection Factor* (PF) expresses the relation between the amounts of radiation that would be received by an unprotected person and a person inside the shelter. Thus, an unprotected person would receive 40 times more radiation than a person inside a shelter with a PF of 40.

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. *Geometric shielding* places people out of the direct path of radiation or at some distance from it. *Barrier shielding* places mass between the shelter occupant and the radioactive source.




**BARRIER SHIELDING**

**Exposure reduced by attenuating mass.**

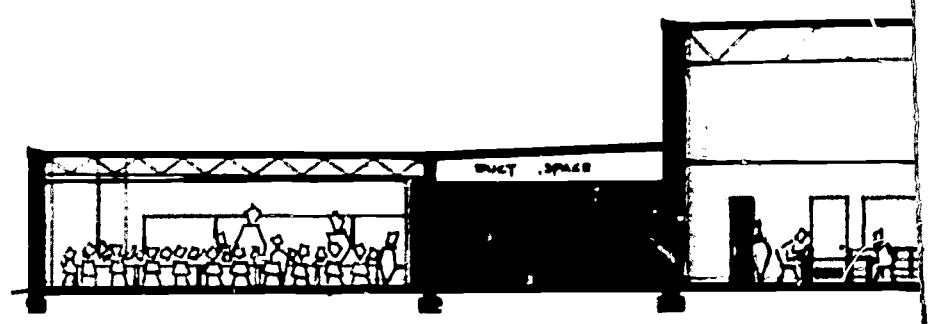



**GEOMETRIC SHIELDING**

**Expesure is reduced as distance from source increases, being out of the direct radiation path.**

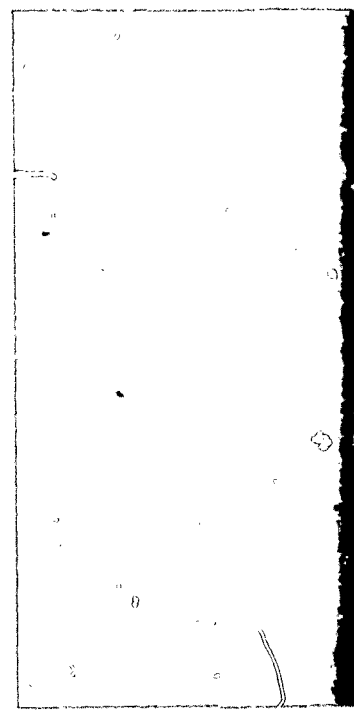
## South Salem Elementary School

**Salem, Virginia**
**Guerrant and Mounfield, AIA, Architects**
**Roanoke, Virginia**




**Section**

**Exterior Perspective**



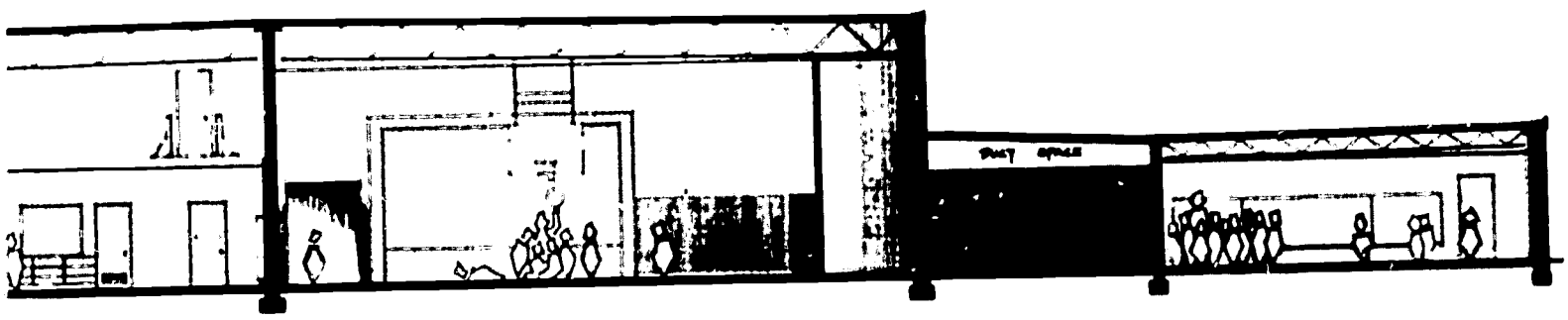
This one-story air-conditioned circular school was designed to provide classroom flexibility and implement team-teaching concepts for a student capacity of 630. Classrooms located along the outside peripheral ring are grouped in clusters of three units. Classrooms are separated by folding partitions. An inside corridor rings the classrooms and provides access to the cafeteria, auditorium, and library area in the center of the school. This corridor ring is widened at several points into common-space areas, each serving a group of three classrooms.

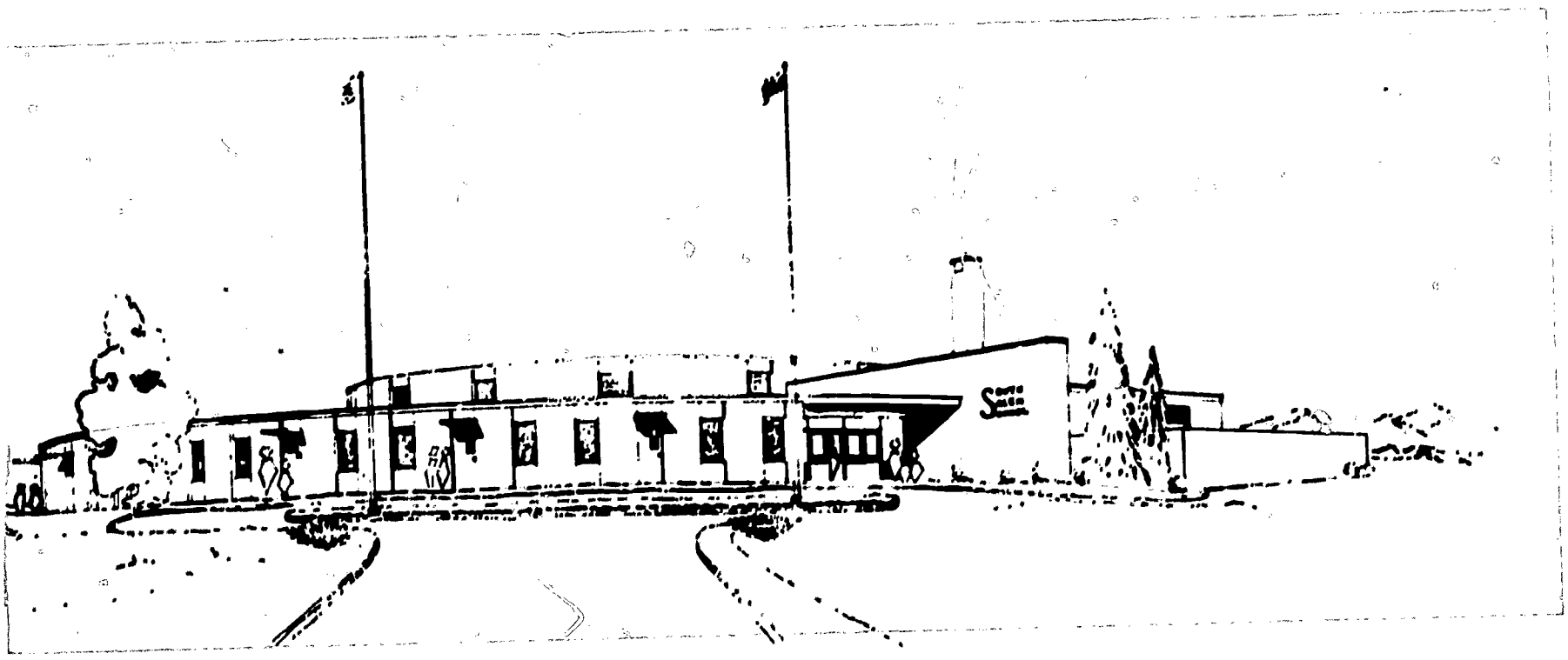
The shelter area is located in the inside corridor ring and common-space areas. Shelter was obtained by providing a 6½-inch concrete slab over the inside ring instead of a conventional steel truss system. Additional shielding was obtained by use of masonry corridor walls and exterior walls with minimum window areas in the classrooms. Abovegrade shelter space is available for virtually all of the students.

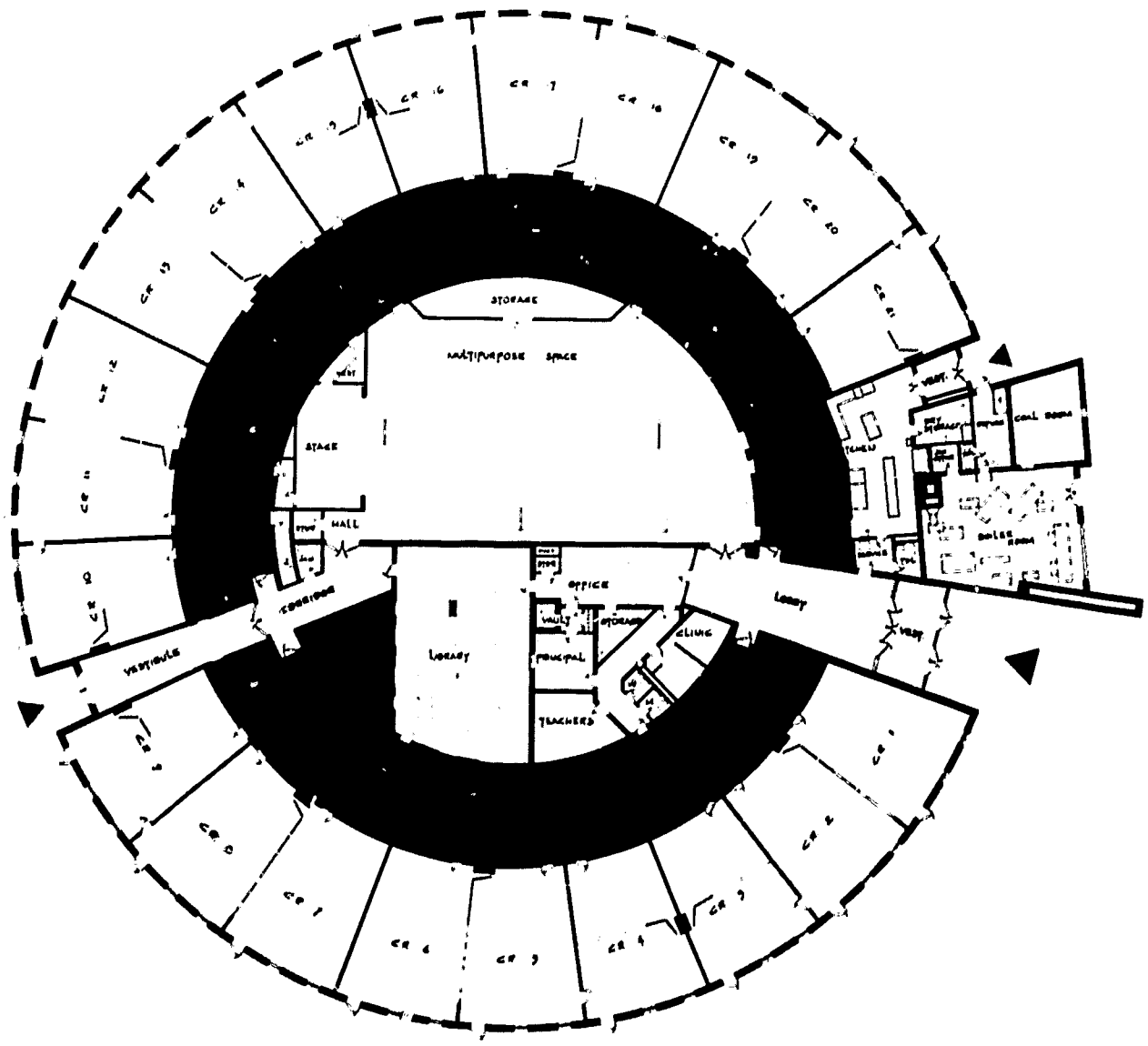
*Construction Cost:*
**$437,400 or $11.60 per sq. ft.**

*Shelter Cost:*
**$6,000 or $0.16 per sq. ft. of school area**

*Shelter Area:*
**Approximately 6,300 sq. ft.**

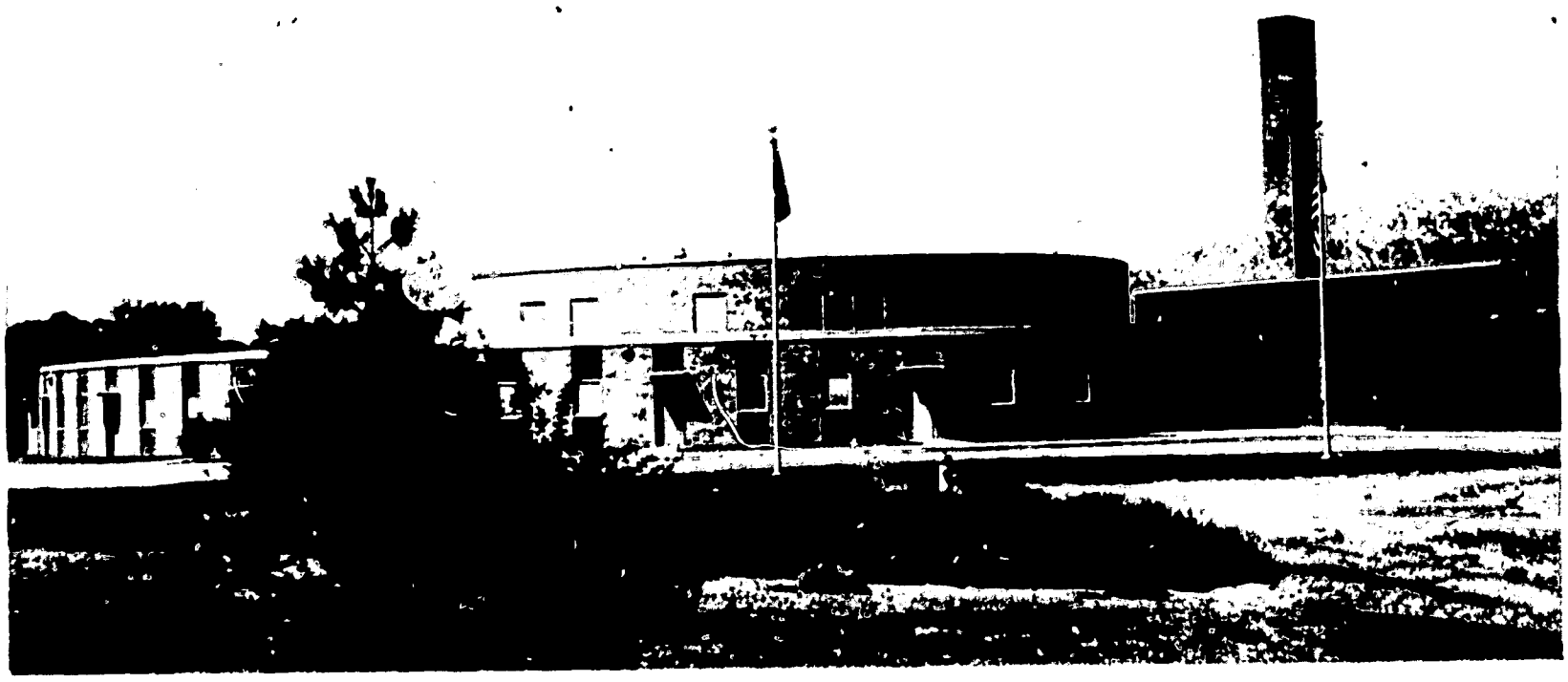







**Floor Plan**

**Section**



## Homer High School

**Homer, Louisiana**
**Joseph P. Schierer, AIA, Architect**
**Shreveport, Louisiana**

This school is part of a campus that encompasses all school grades in the community. Student capacity of the high school is approximately 700. An addition to the high school was made in 1964 which provided a gymnasium, cafeteria, and music room facilities in a separate building of the school campus. Covered walkways link the addition to the other campus buildings.

Shelter for 930 persons is located in the boys' and girls' locker rooms beneath the sloping concrete bleachers at each side of the gymnasium. Additional shelter space is provided in the storage room beneath the gymnasium foyer and calisthenics rooms.

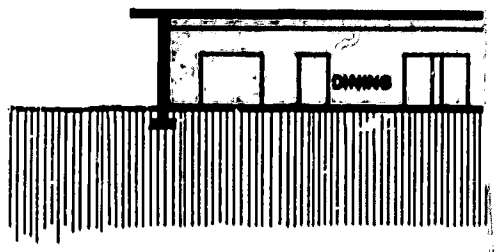
The decision to add shelter to the new facility was influenced by the frequency of natural disasters (tornadoes) common to the region, as well as the possibility of nuclear fallout hazard.

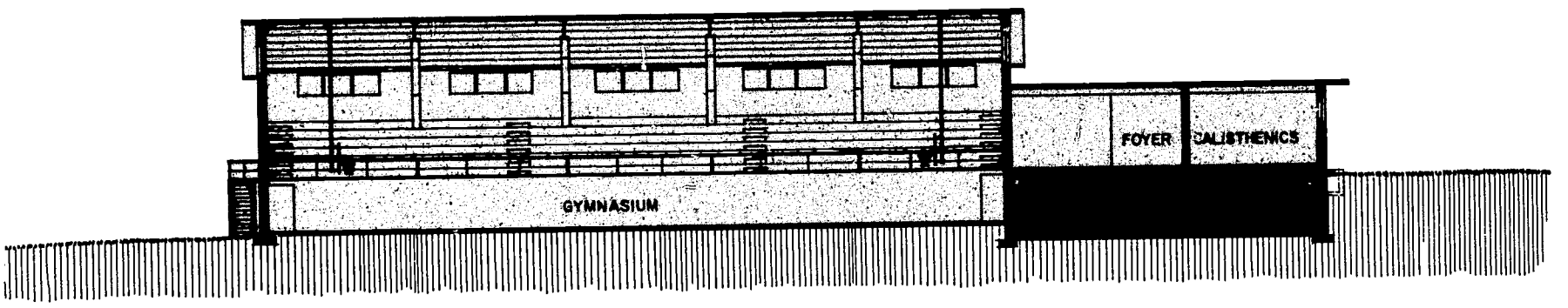
*Construction Cost:*
**$336,713 or $8.62 per sq. ft.**

*Shelter Cost:*
**$23,455* or $0.60 per sq. ft.* of school area**

*Shelter Area:*
**9,560 sq. ft.**

** Cost shown includes shelter as well as 6,169 sq. ft. of additional school space which would not ordinarily have been obtained.*



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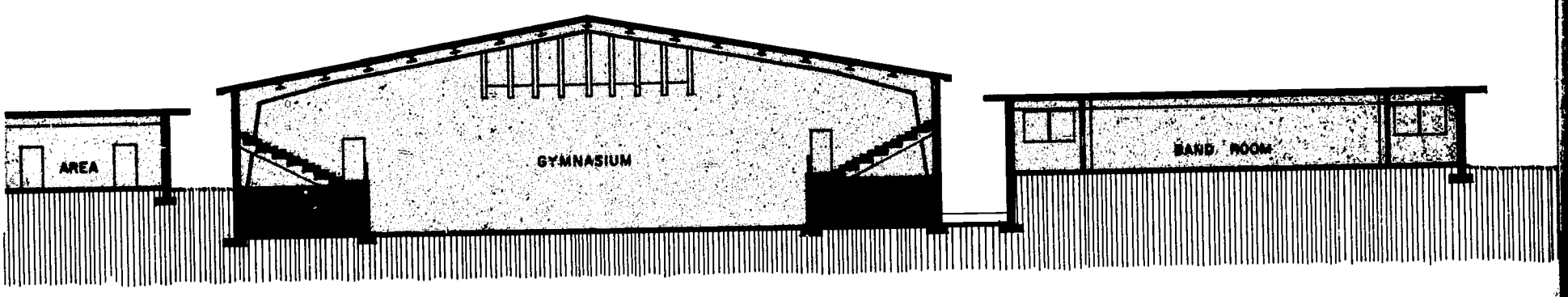
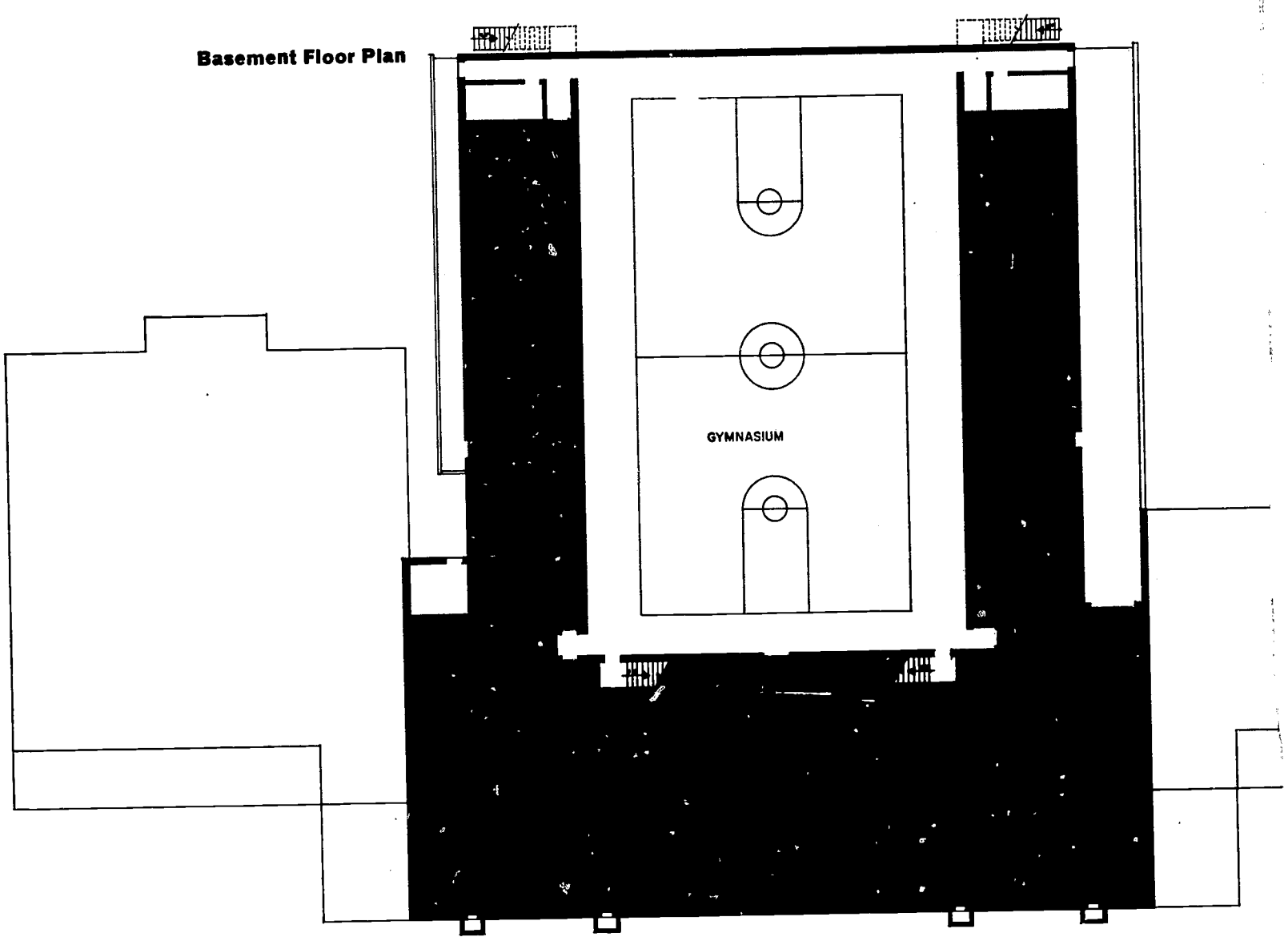
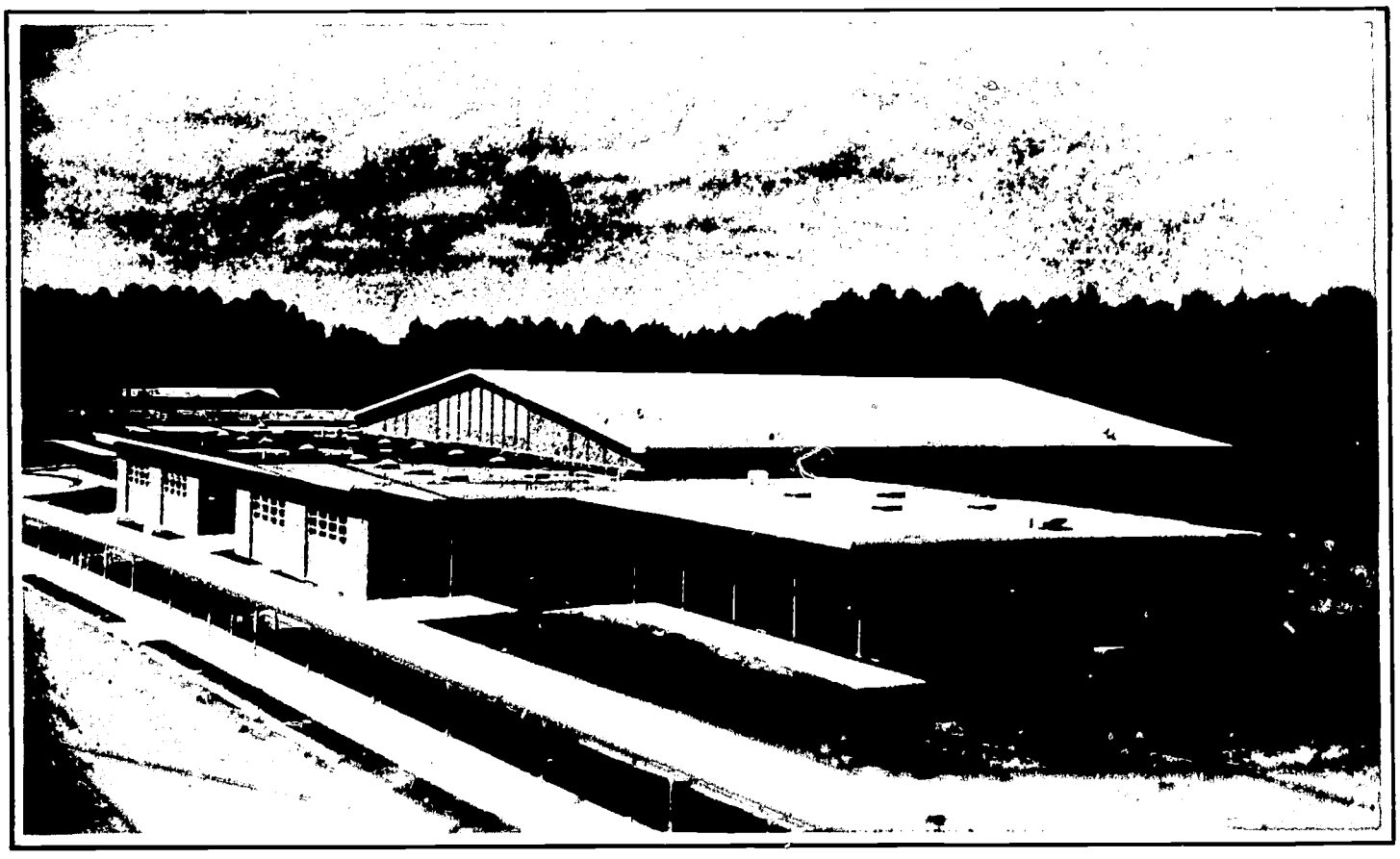



**Section**

**Basement Floor Plan**





## Lorenzo Senior High School

**Lorenzo, Texas**
**Dewitt and Spencer, AIA, Architects**
**Lubbock, Texas**

This senior high school, programmed for 300 students, was added to a campus with an existing elementary and junior high school. The new building answered two needs—completing the desired community coverage of academic levels and providing emergency shelter for approximately 700 students. The logic of planning for fallout protection was reinforced by the fact that the community is located in a "tornado alley."

The school's fallout shelter area is below grade, in an air-conditioned cafeteria and kitchen beneath an interior courtyard. The shelter is accessible from an entrance foyer of the school and also from an outside door that provides a link to the other buildings on the campus.

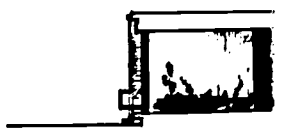
All classrooms are aboveground. Placing the service-shelter area underground for stronger adaptation to dual use required installation of a service elevator for deliveries. The $10,000 cost of the service elevator is the only cost item directly attributable to the inclusion of shelter.

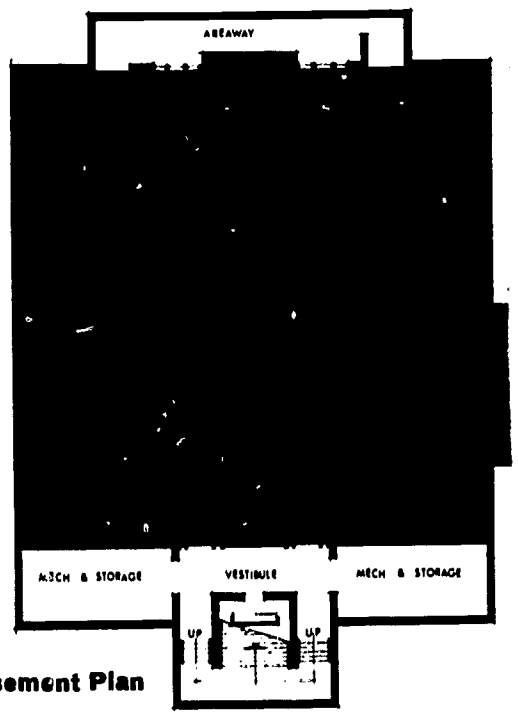
*Construction Cost:*
**$660,935 or $12.22 per sq. ft.**

*Shelter Cost:*
**$10,000 or $0.18 per sq. ft. of school area**

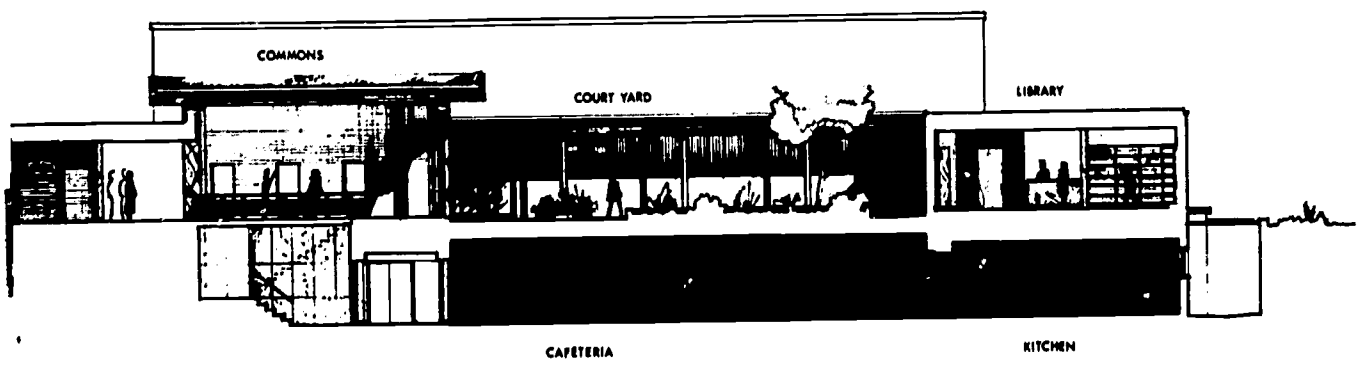
*Shelter Area:*
**Approximately 7,000 sq. ft.**

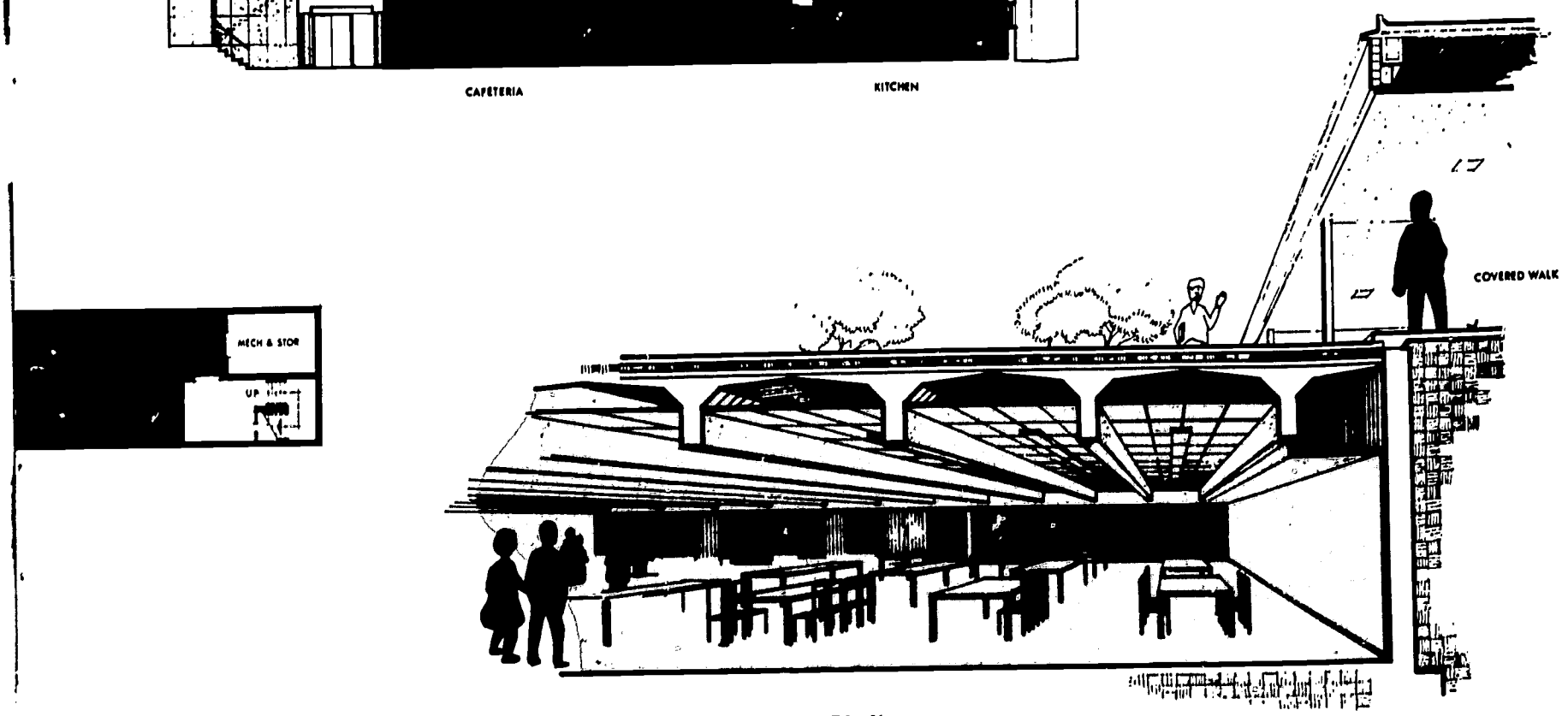
**Section**



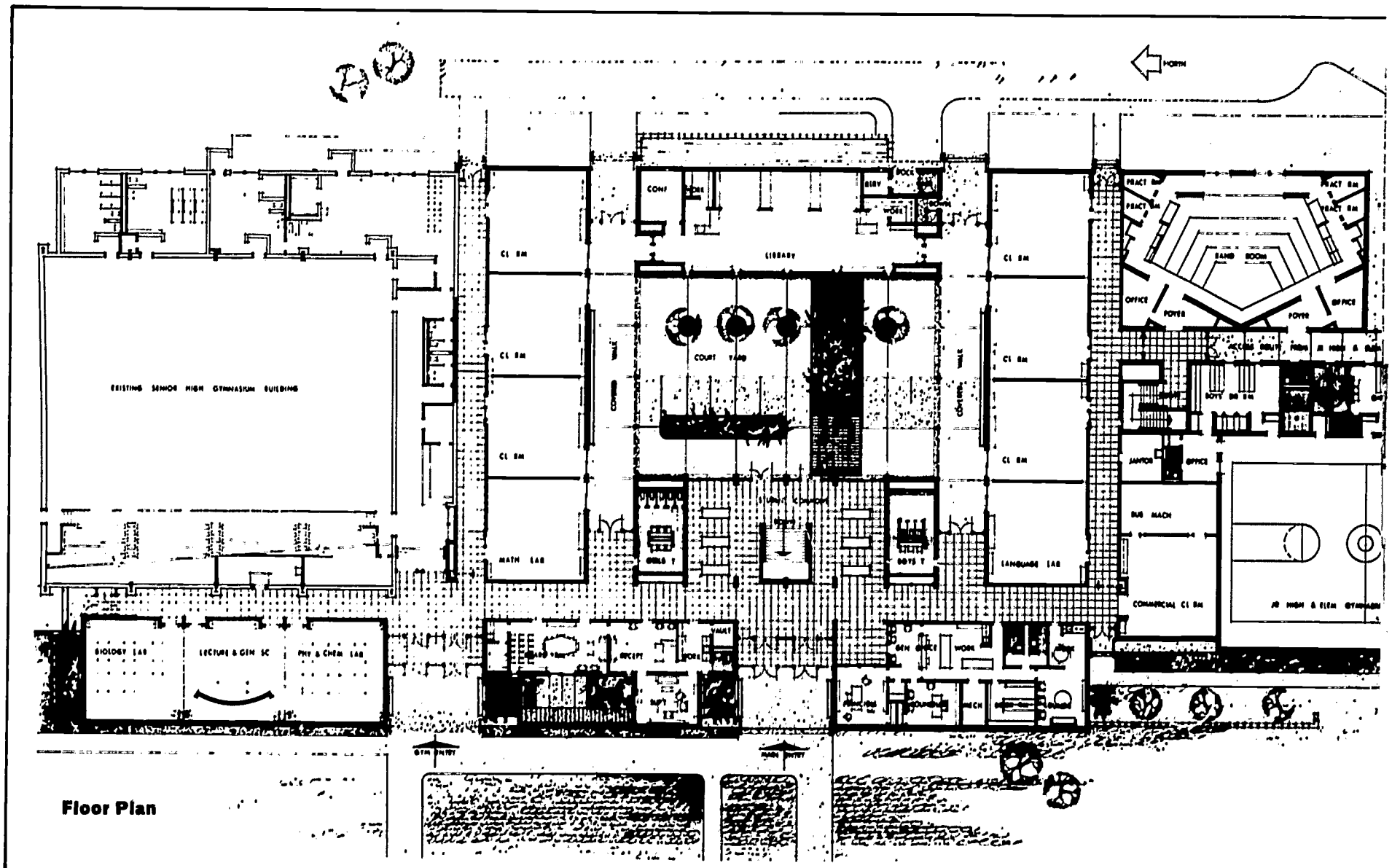



**Basement Plan**

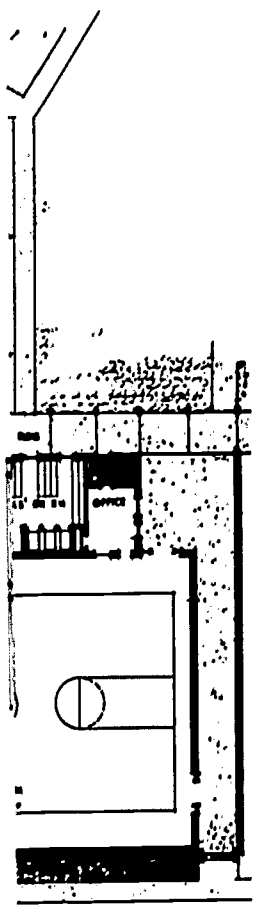


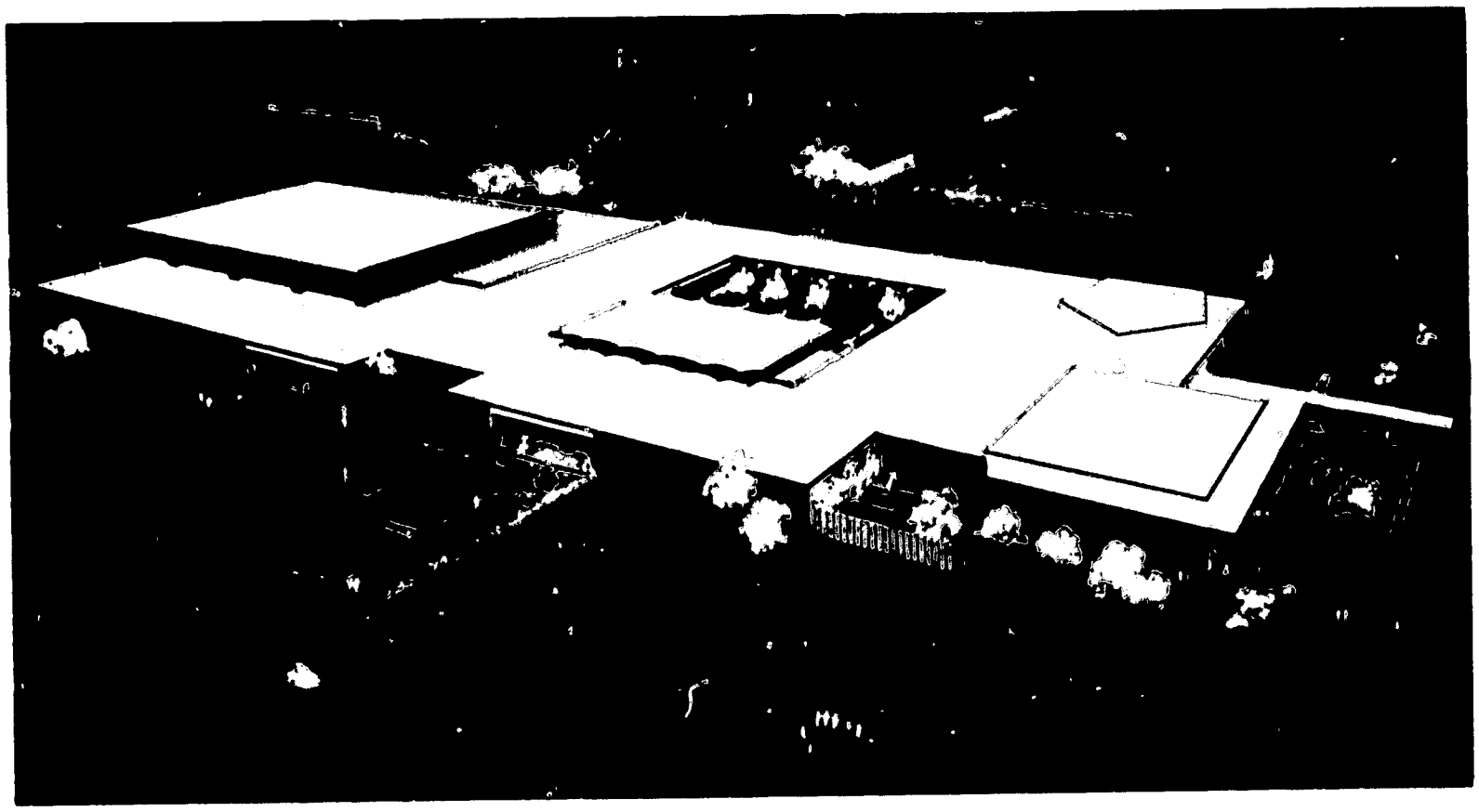




**Sectional Perspective Cafeteria and Shelter**


NORTH
EXISTING SENIOR HIGH GYMNASIUM BUILDING
CL RM
CONF
LIBRARY
COURT YARD
COVERED WALK
MATH LAB
GIRLS T
BOYS T
LANGUAGE LAB
BIOLOGY LAB
LECTURE & GEN SC
PHY & CHEM LAB
PRACT RM
BAND ROOM
OFFICE
FOYER
BOYS DR RM
JANITOR
BUS MECH
COMMERCIAL CL RM
GYM ENTRY

**Floor Plan**





**Exterior Perspective**

## West Islip Senior High School

**West Islip, Long Island, New York**
**Frederic P. Wiedersum Associates, AIA Architects**
**Valley Stream, Long Island, New York**

Planning for rapid community growth and for emergency protection was incorporated in the design of this dual-use school addition. The construction of a two-story classroom wing and a gymnasium wing to accommodate an increased student capacity presented an economic opportunity to build fallout shelters beneath the standard facilities.

Multiple use of the belowgrade areas adds to their year-round value. The shelter area beneath the gymnasium will be used for locker rooms, team rooms, storage and corrective education. Additional shelter space is located under the new classroom wing, which has a structural concrete roof that will permit the addition of a third floor when further expansion becomes necessary.

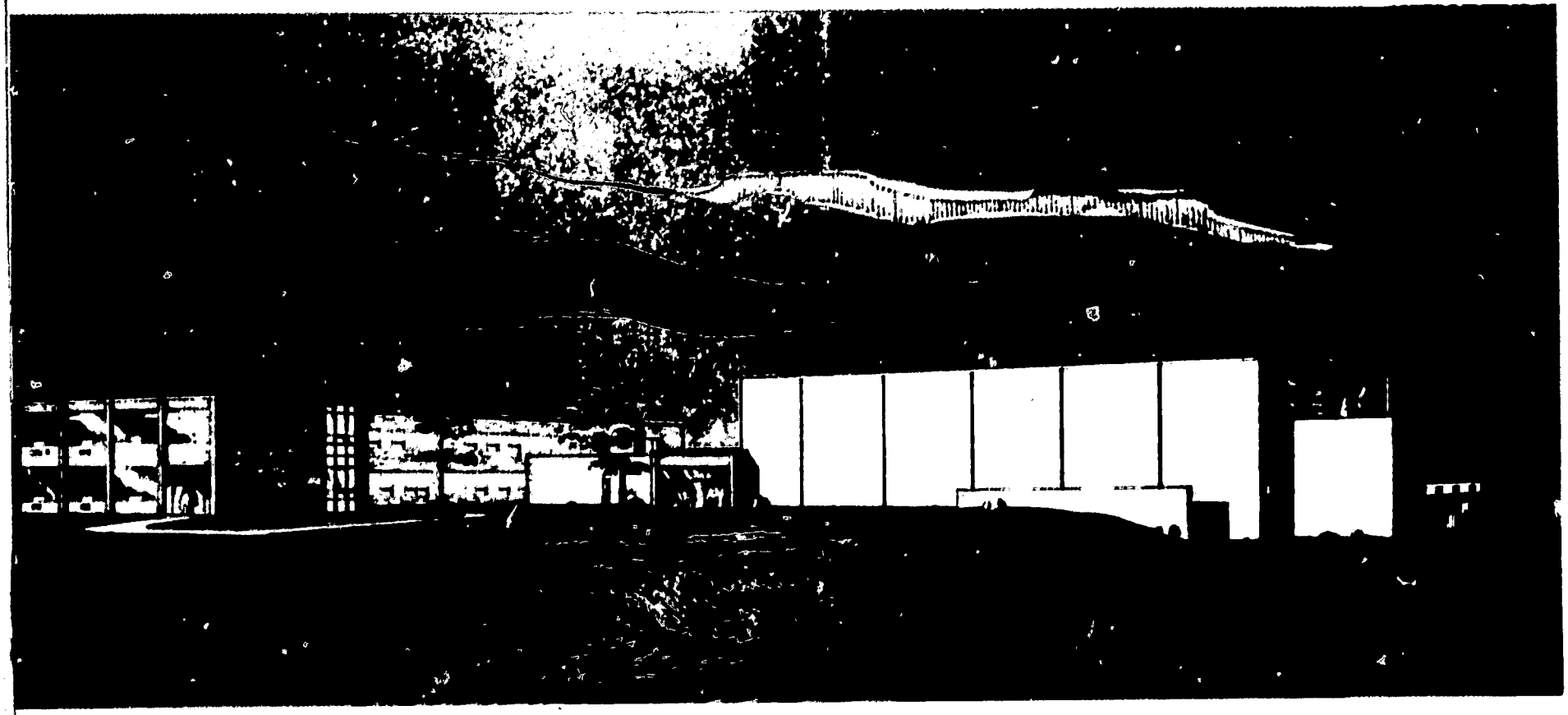
The total shelter capacity of 3,319 persons is sufficient to serve the senior high school and several other nearby schools.

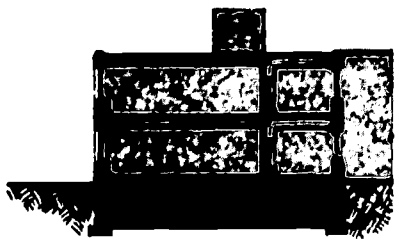
*Construction Cost:*
**$2,426,858 or $16.62 per sq. ft.**

*Shelter Cost:*
**$85,000 or $0.58 per sq. ft. of school area**

*Shelter Area:*
**33,194 sq. ft.**

**Perspective**

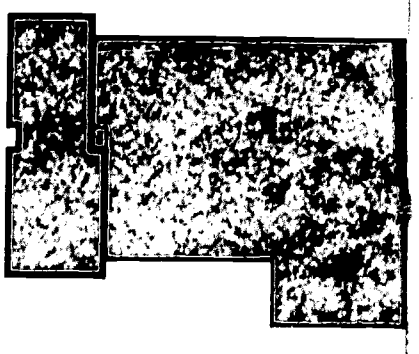




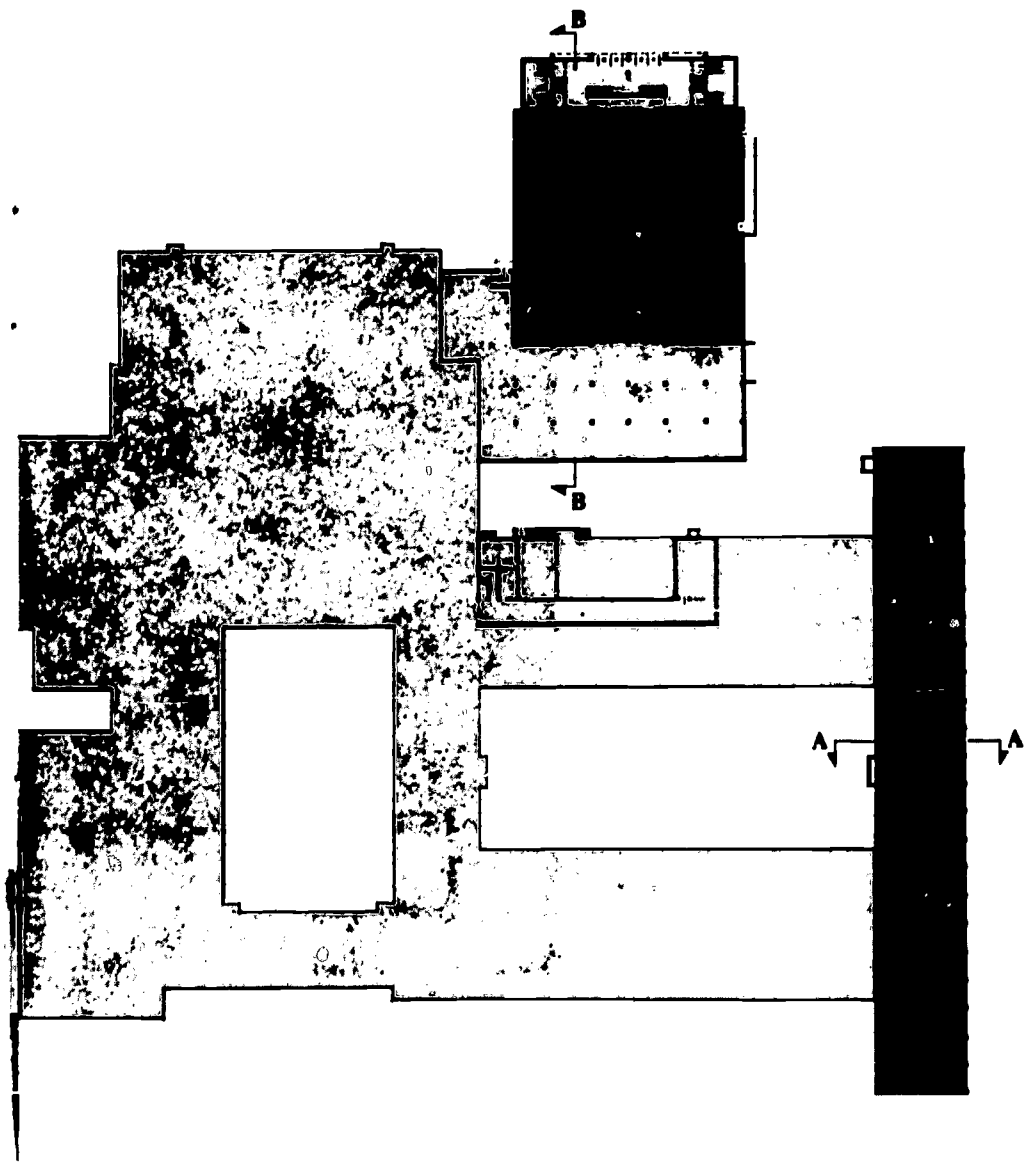
Section A-A

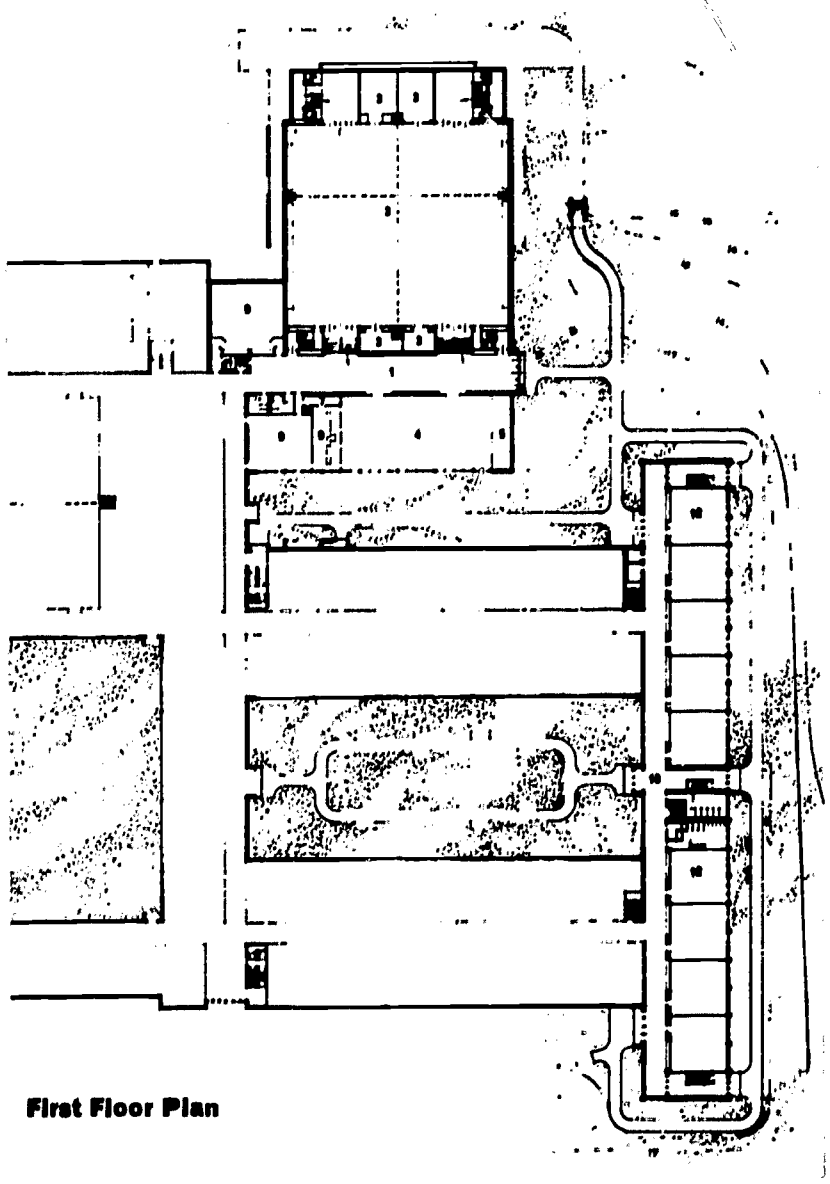
Basement Plan

Section B-B



SCALE



First Floor Plan

## St. Joseph Grade School

**St. Joseph, Illinois**
**Glenn G. Frazier and Associates, AIA, Architects**
**Urbana, Illinois**

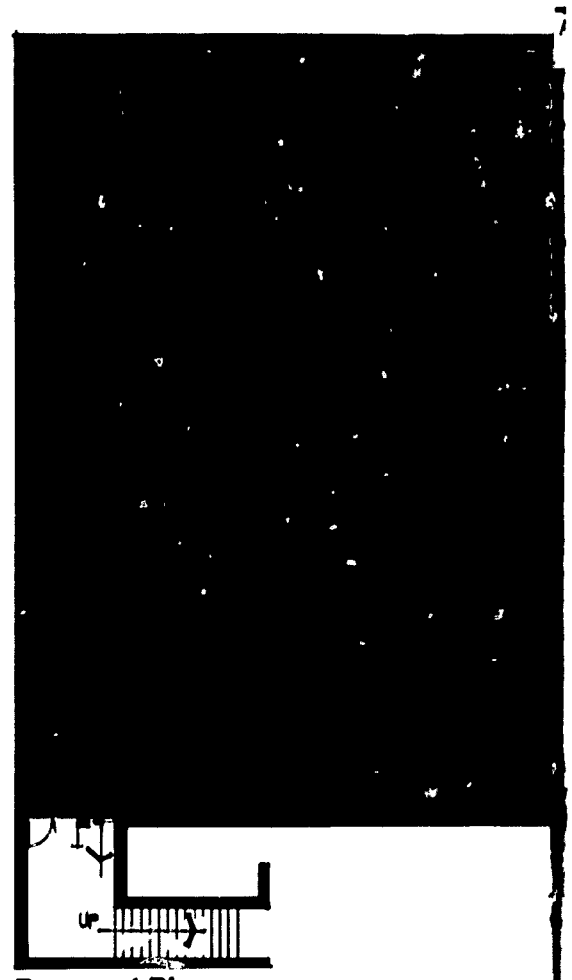
This school modification illustrates the value and relative ease of using below-grade space for both school services and fallout protection. The area beneath the classroom addition was designed for normal use as an indoor play room, assembly and visual aids area, lunchroom overflow facility and community meeting and activity hall—and also provides at little additional cost a fallout shelter for 650 persons.

Built-in fallout protection is provided by the first-floor concrete slab and poured concrete walls. The shelter area is accessible from the first floor of the school by an interior stairway; it also has a direct exterior exit to a service yard and parking area. All access to the shelter takes advantage of shielding walls. An underground tunnel connects the shelter area to existing below-grade cafeteria space, improving student traffic patterns and providing protected passage to a kitchen area that can be used as shelter. Cafeteria space can also be used for recreation and exercise on a short-term basis. The shelter spaces are designed to enclose shower and dressing areas, storage room and a small office for shelter officers.

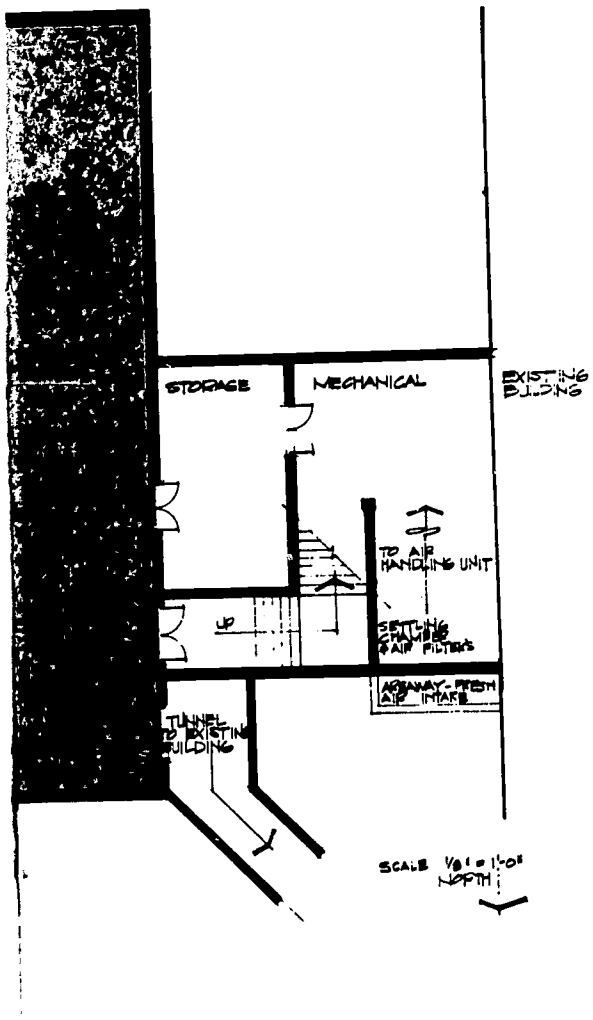
*Construction Cost:*
**$187,623 or $11.04 per sq. ft.**

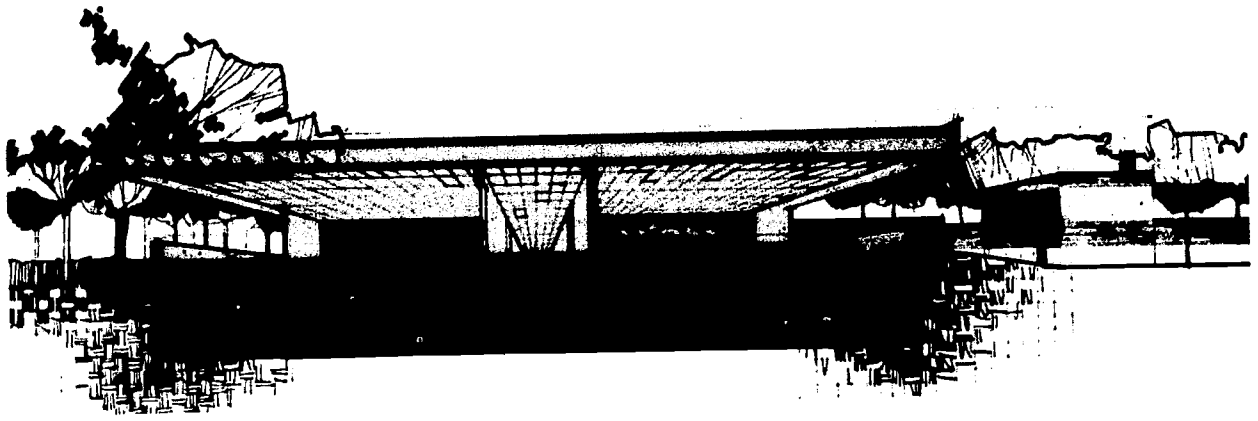
*Shelter Cost:*
**$7,500 or $0.44 per sq. ft. of school area**

*Shelter Area:*
**6,800 sq. ft.**




**Basement Plan**



**Sectional Perspective**

## Junior High School 55

**Borough of Brooklyn, New York**
**Curtis and Davis, AIA, Architects**
**New York, New York**

This junior high school is a five-story, reinforced-concrete structure intended to accommodate 1,900 students and teachers. The exterior of the building is essentially windowless. The decision to design without exterior windows was based solely on operating and maintenance considerations. The design provides for an interior courtyard area on the third and fourth floor levels. The ground floor level contains the cafeteria and storage areas and can provide approximately 600 shelter spaces. Shelter space for an additional 2,600 persons is also available on the first, second and third floor levels of the school.

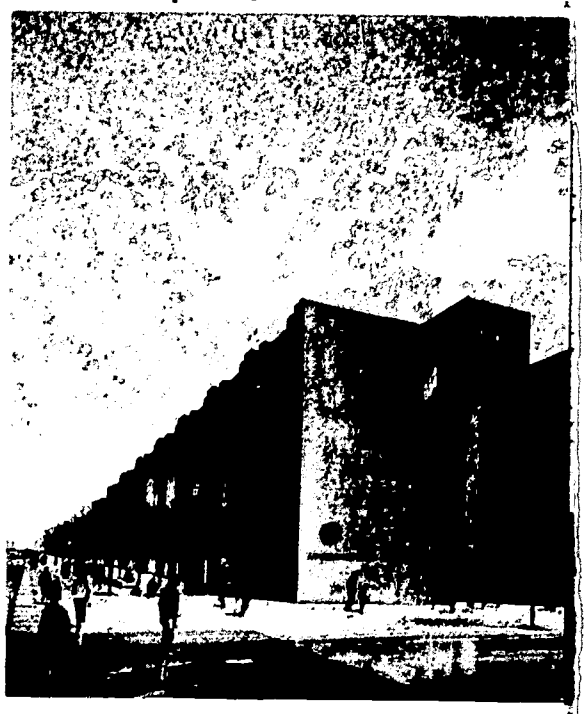
The shelter features were inherent in the basic building design and, therefore, were included at no additional cost to the owner.

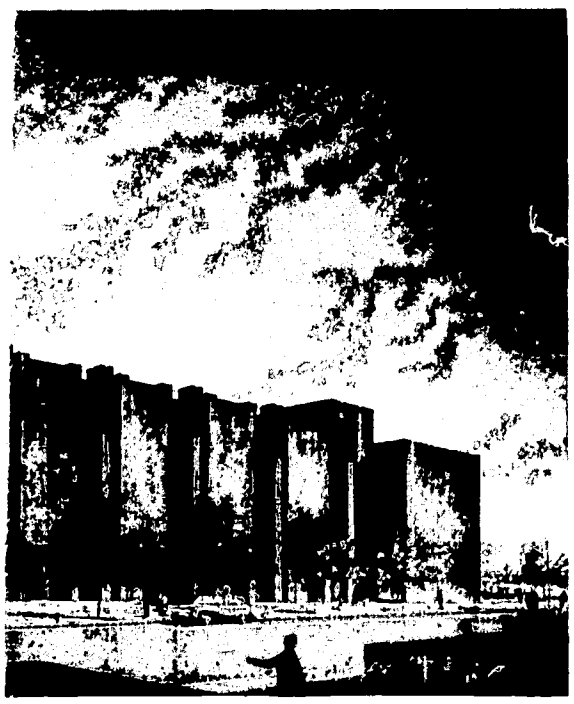
*Construction Cost:*
**$4,046,220 or $23.40 per sq. ft.**

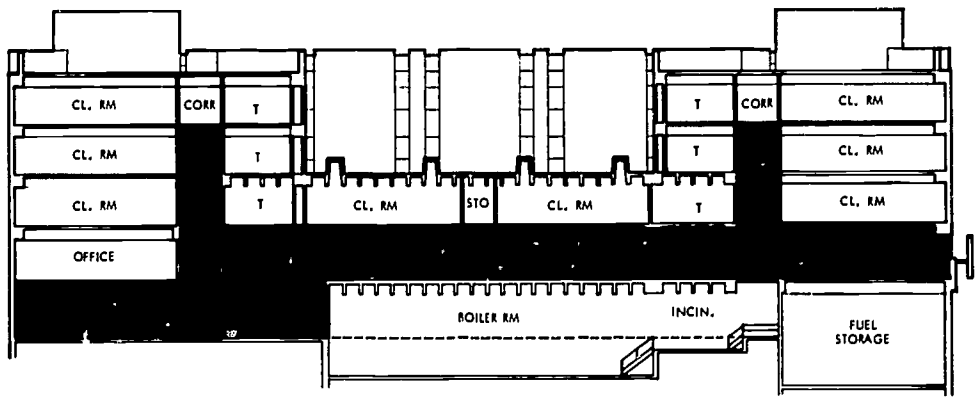
*Shelter Cost:*
**None—inherent in basic design**

*Shelter Area:*
**Approximately 32,000 sq. ft.**

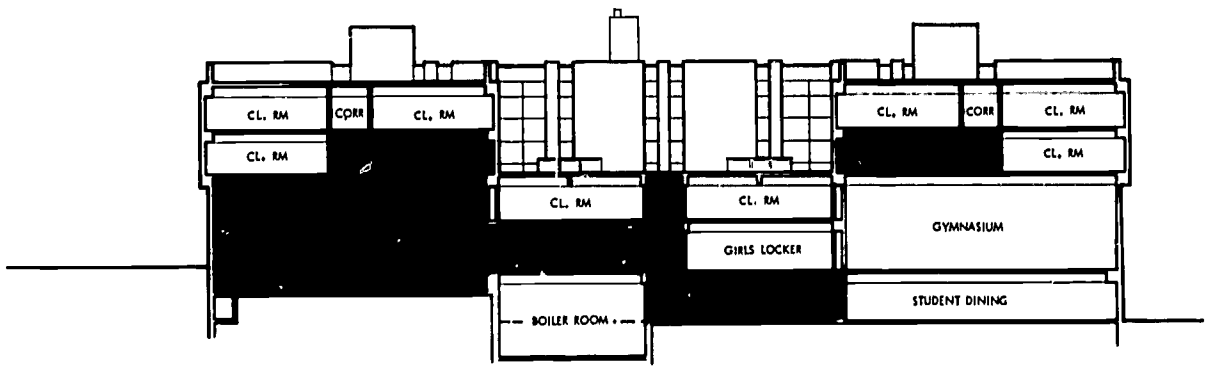
**Exterior Perspective**





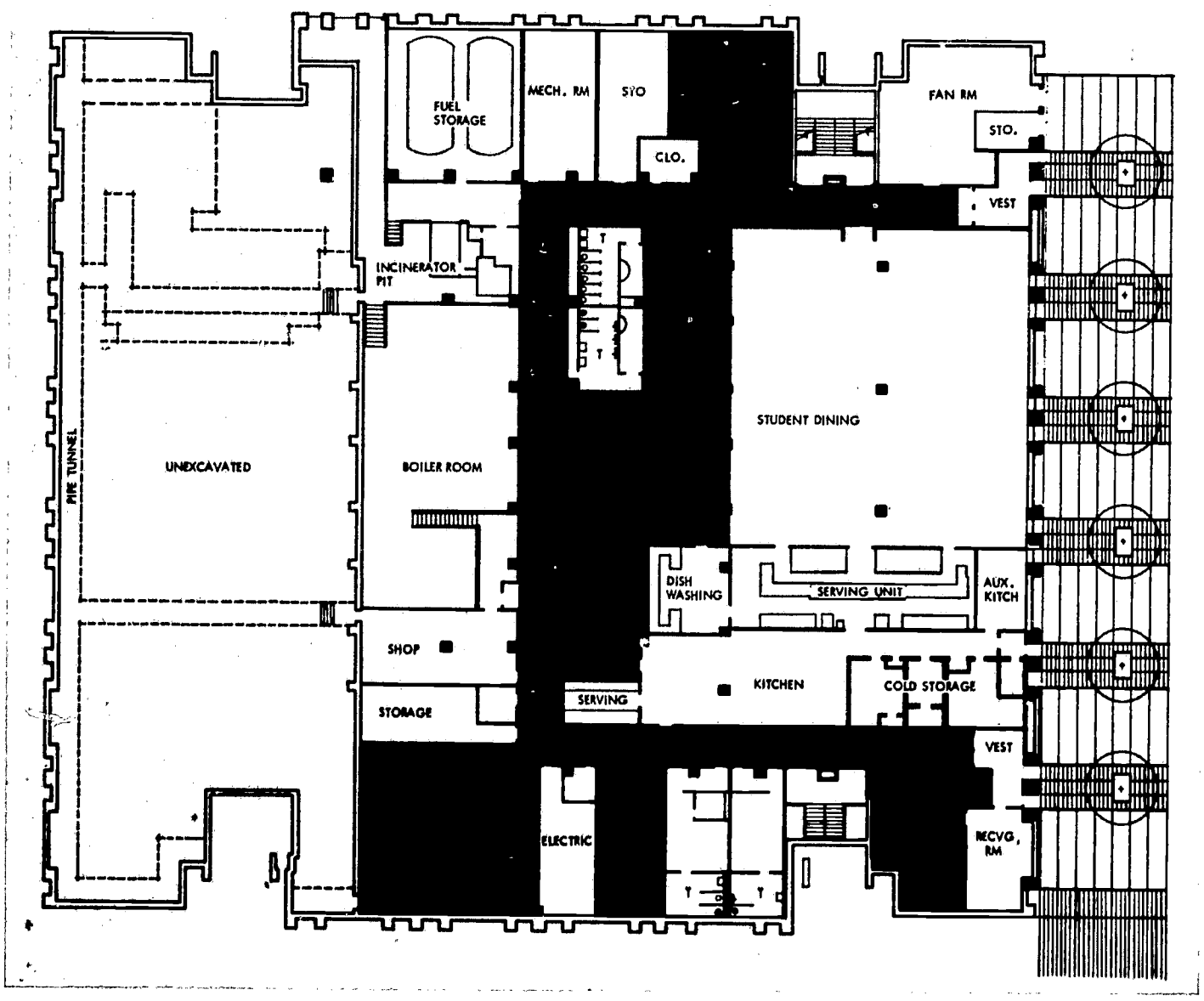


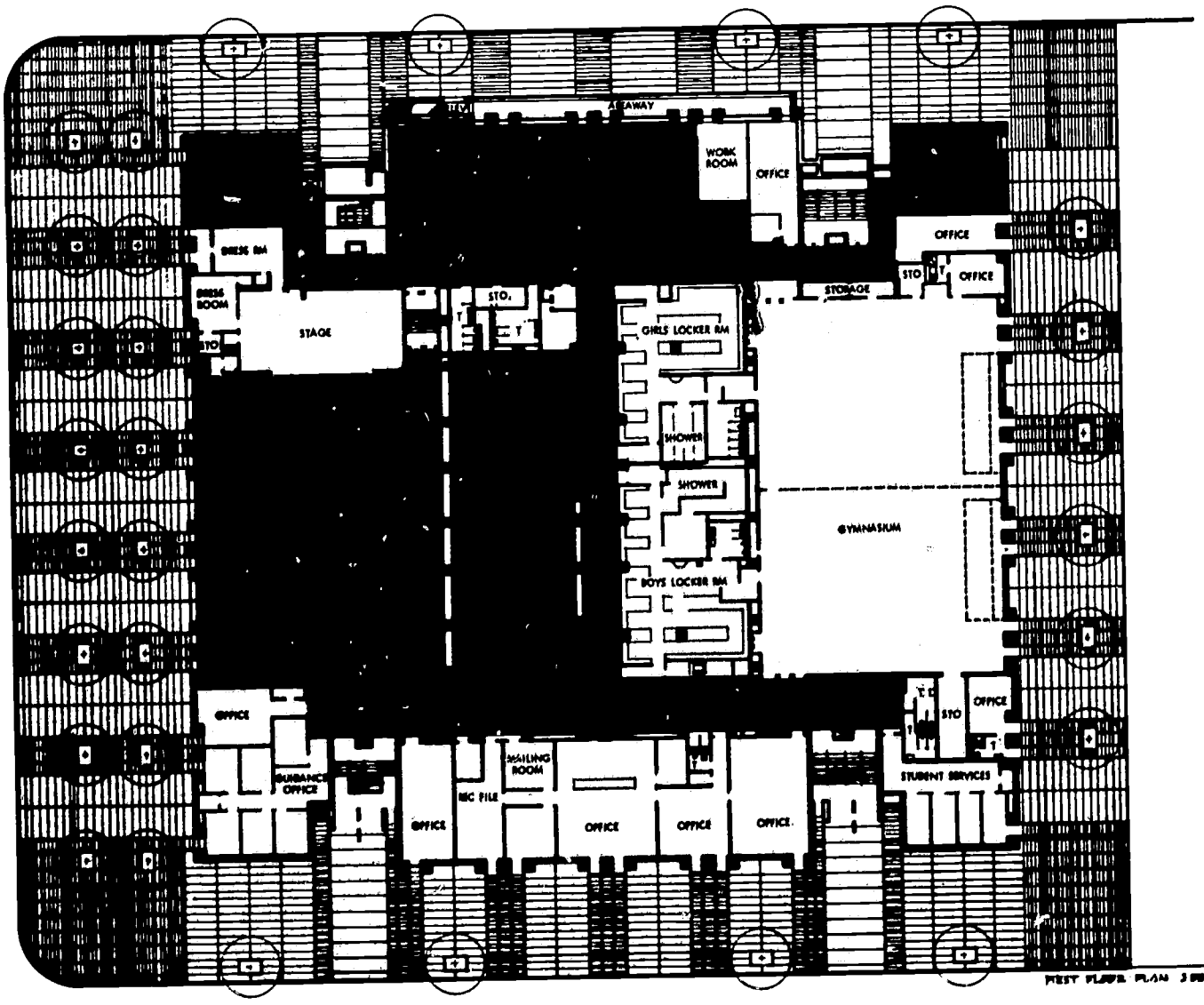

**Section**




**Section**

**Ground Floor Plan**






First Floor Plan

## South San Antonio School Cafetorium

**San Antonio, Texas**
**Paul L. Garcia, AIA, Architect**
**San Antonio, Texas**

This cafeteria-assembly building was designed to serve approximately 500 students of an elementary and junior high school complex. Common use of the new structure naturally dictated its location between the existing classroom buildings —a location affording inherent protection from fallout due to the shielding effect of the adjacent buildings. Design criteria for the new building were slanted to provide fallout protection at little additional cost. The roof of reinforced concrete, for example, is a protective feature, but it is also part of structural planning for a future second story to increase classroom space. Walls are constructed of 6-inch concrete panels with 2-inch air spaces, finished with a 4-inch brick facing that matches the exterior of the other buildings in the complex.

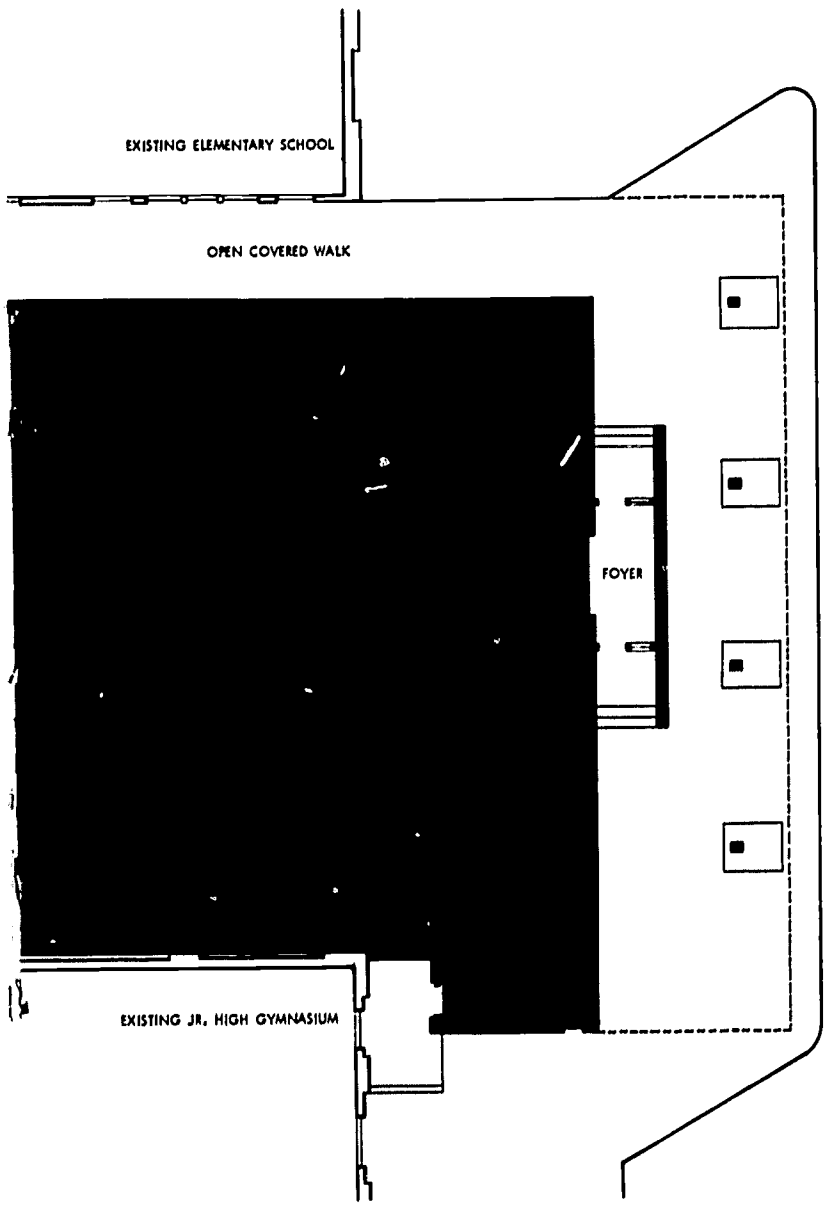
The common "cafetorium" provides fallout shelter for 680 persons. The upgrading of the building design to include shelter presented no special problems of construction or space utilization and was achieved at minimal cost.

*Construction Cost:*
**$110,000 or $15.95 per sq. ft.**

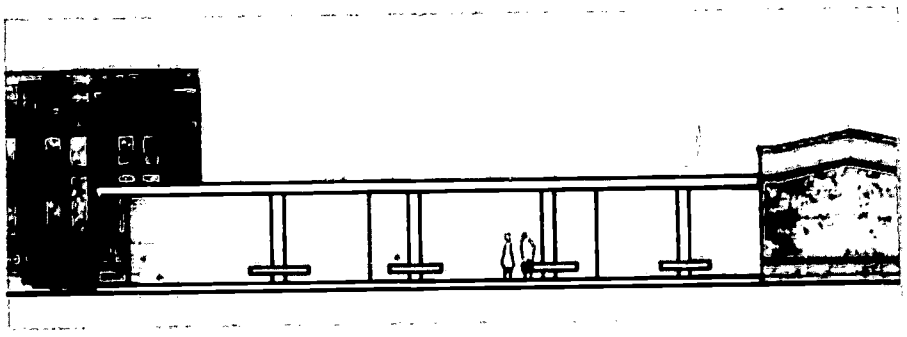
*Shelter Cost:*
**$2,000 or $0.29 per sq. ft. of school area**

*Shelter Area:*
**6,800 sq. ft.**

**Cafeteria and Shelter**




**Exterior Perspective**



**Elevation**

## Blackwell Senior High School

**Blackwell, Oklahoma**
**Caudill, Rowlett and Scott, AIA, Architects**
**Houston, Texas**

The principal aim in the design of this school was to create a stimulus to individual study outside the classroom. To accomplish this, the school was built around a large, open study center where each of the 600 students has his own home base—desk and locker-drawer—with library resources, teacher consultation and dining areas arranged around the student area.

Beneath the study center, a little theater carries out the theme of personalized learning—and also provides an emergency facility that is dual-purpose in its own right, protecting the school community against possible fallout hazards and probable tornadoes. The combined facility provides a specialized tornado shelter and fallout protection for 406 persons.

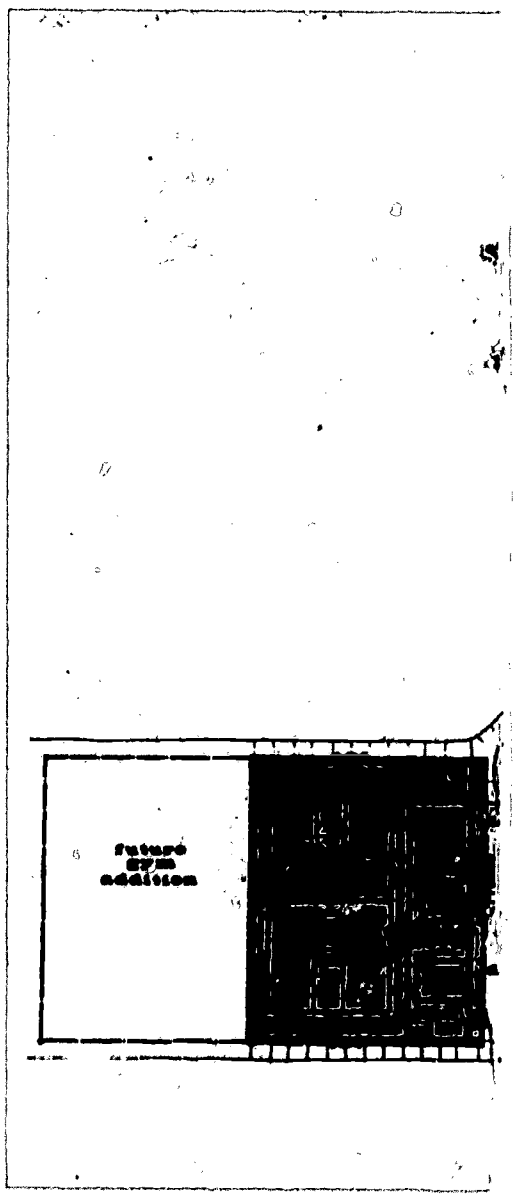
Overall construction of the school includes steel beams, purlins and trusses, and load-bearing masonry walls.

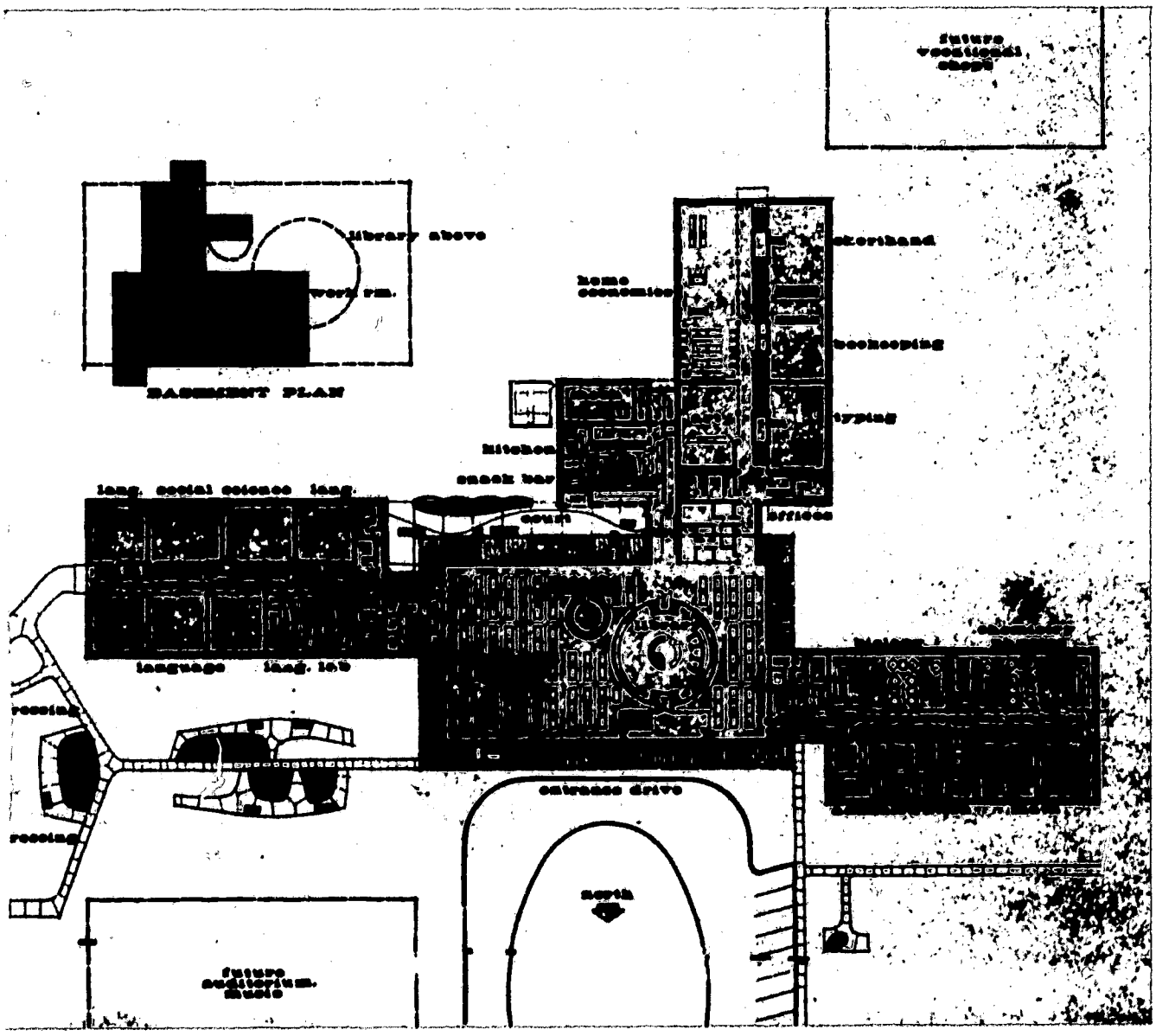
*Construction Cost:*
**$858,347 or $12.60 per sq. ft.**

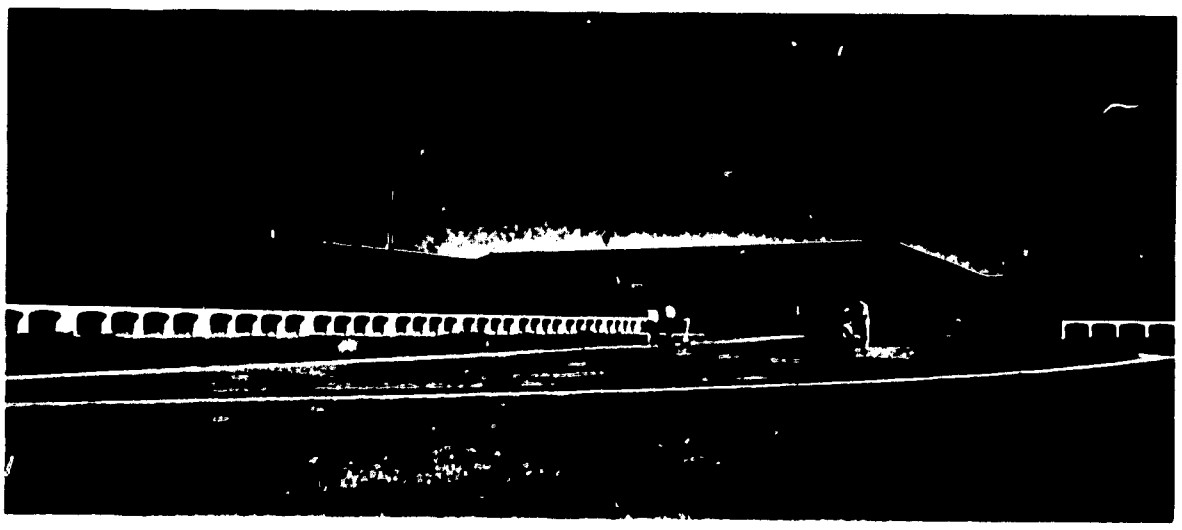
*Shelter Cost:*
**None—inherent in basic design**

*Shelter Area:*
**4,880 sq. ft.**

**Floor Plan**




future vocational shops
library above
work rm.
BASEMENT PLAN
shorthand
home economics
bookkeeping
typing
kitchen
snack bar
lang. social science lang.
south
offices
language lang. lab
vending
vending
entrance drive
north
future auditorium-music



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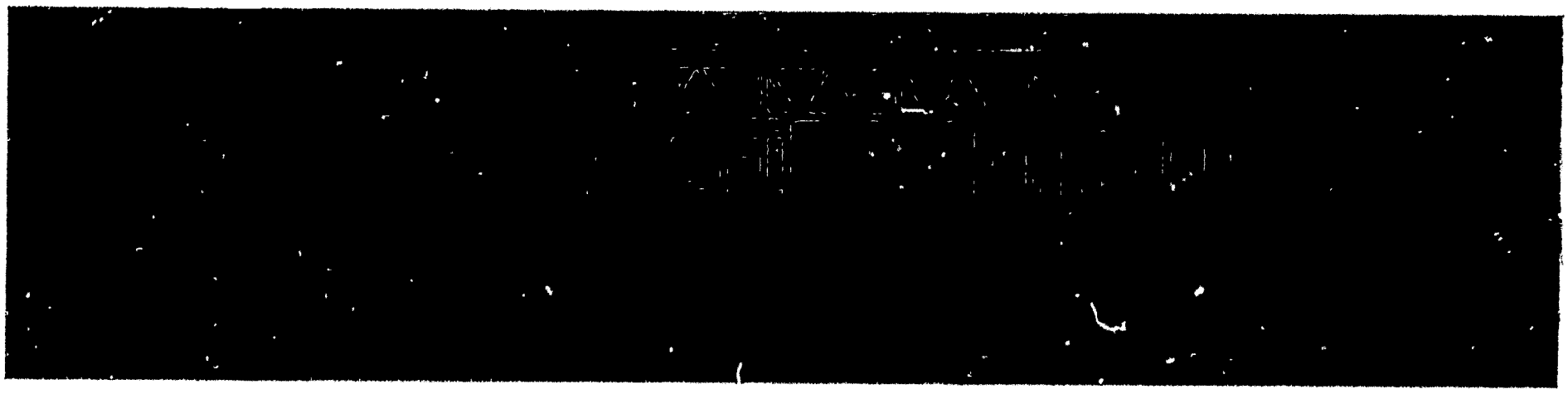
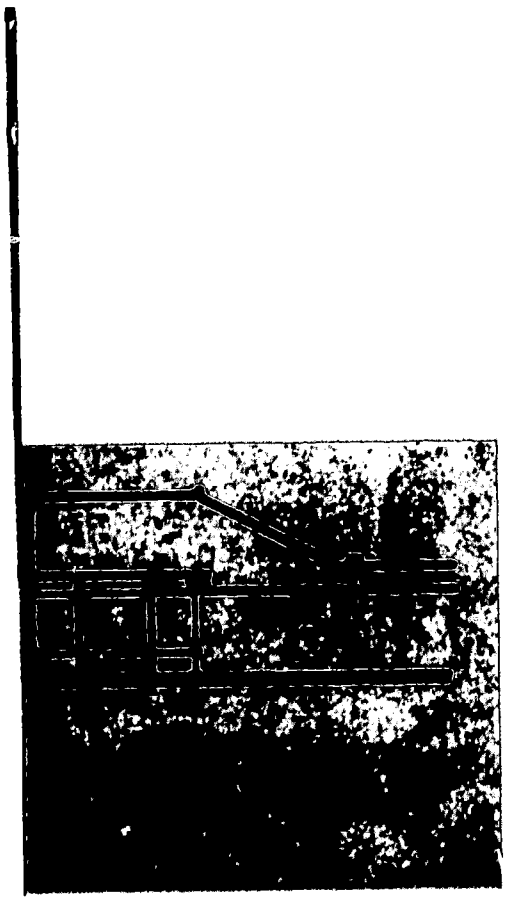




## Henry A. Bradshaw High School

**Florence, Alabama**
**Barr and Tune, AIA, Architects**
**Florence, Alabama**

The design of this school was slanted to provide shelter protection for its 1,000 students with only minor modifications in the standard gymnasium and auditorium facilities.

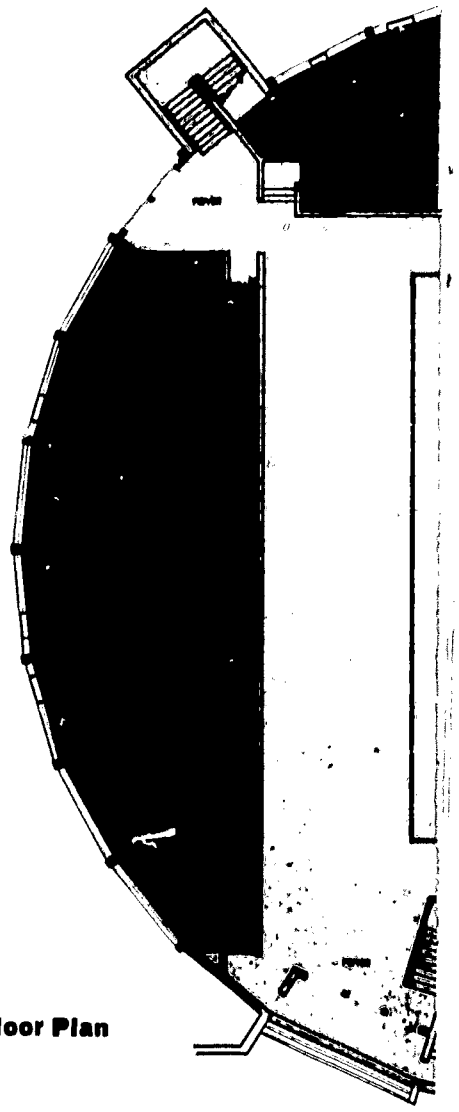
Most of the school's shelter area is located in the gymnasium, a circular structure with wood lamella dome roof and concrete-pan balcony floor. Exterior walls are of standard hollow concrete block, with brick facing. The design was upgraded to protection requirements by filling the exterior block wall and three interior partitions with sand.

The shelter area includes restrooms and is adjacent to cafeteria-kitchen areas. High windows provide natural ventilation and daylight illumination.

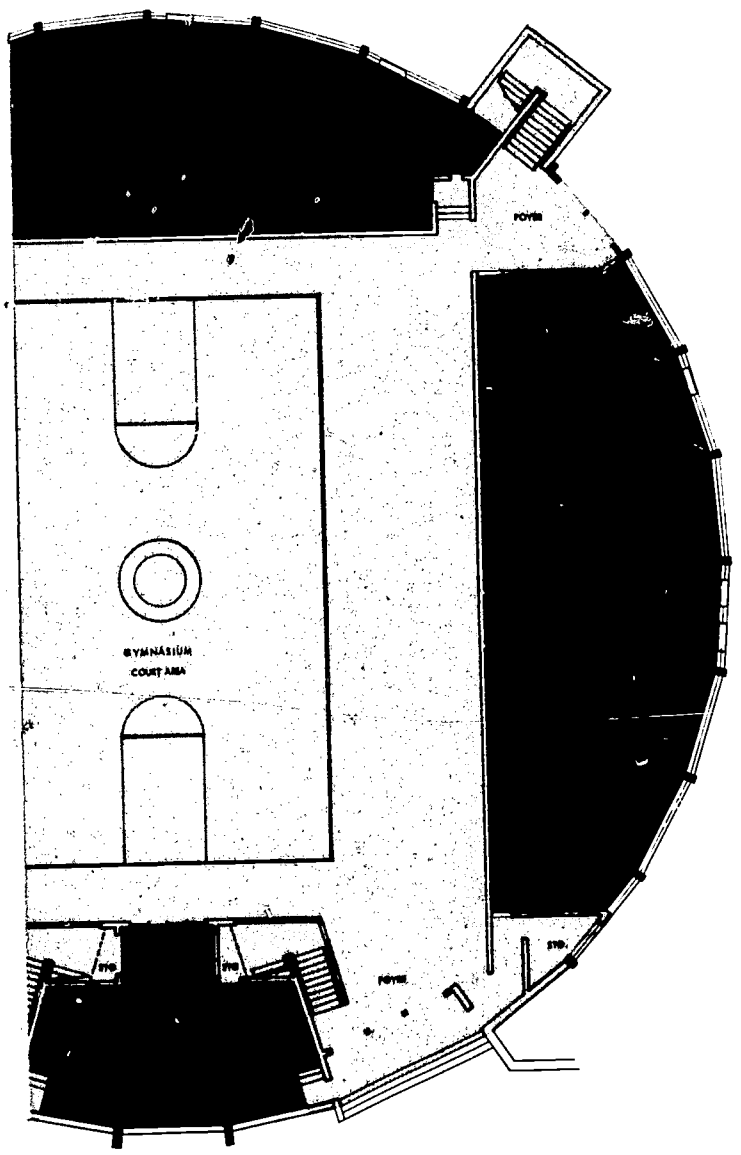
*Construction Cost:*
**$2,000,000 or $13.36 per sq. ft.**

*Shelter Cost:*
**$1,500 or $0.01 per sq. ft. of school area**

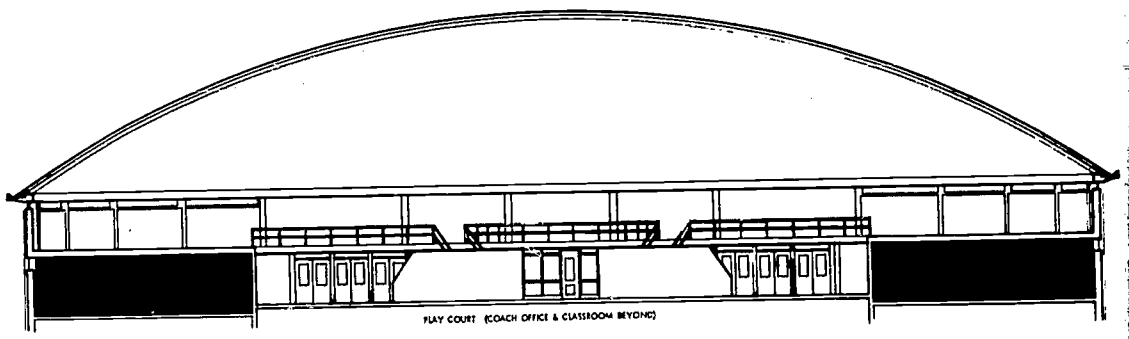
*Shelter Area:*
**10,000 sq. ft.**



**Floor Plan**




**Exterior Perspective**




**Section**

## Bemidji Junior High School

**Bemidji, Minnesota**
**Foss, Engelstad and Foss, AIA, ARA**
**Architects and Engineers**
**Moorhead, Minnesota**

Fallout shelter features were inherent in the design of this two-story school building. Shelter areas are concentrated below grade with other normal-use service areas —cafeteria, kitchen and food-storage facilities—and in exterior tunnels.

The placement of the main shelter spaces takes advantage of mutural shielding from the two-story classroom unit above. The structural floor over the shelter areas consists of concrete joists with an overlying concrete slab.

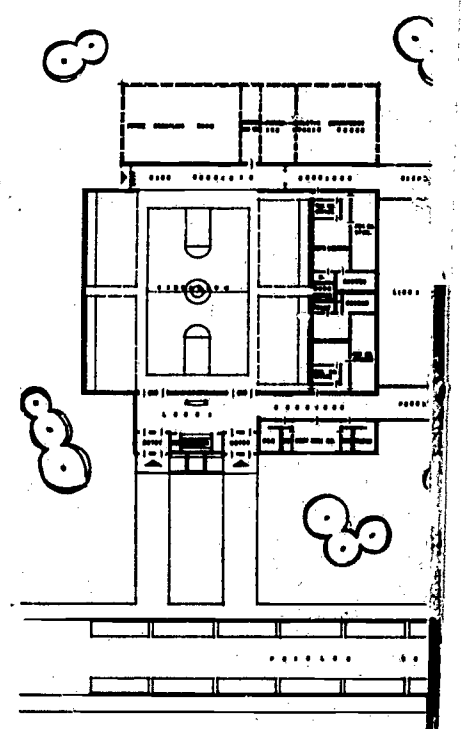
Shelter is also provided in the exterior tunnels, which are long, wide, high ceilinged and well ventilated. The tunnels are topped with a structural concrete slab and a concrete wearing slab.

The school provides 1,200 shelter spaces, which can accommodate the student population of 1,000 and offer protection to employees of nearby business firms.

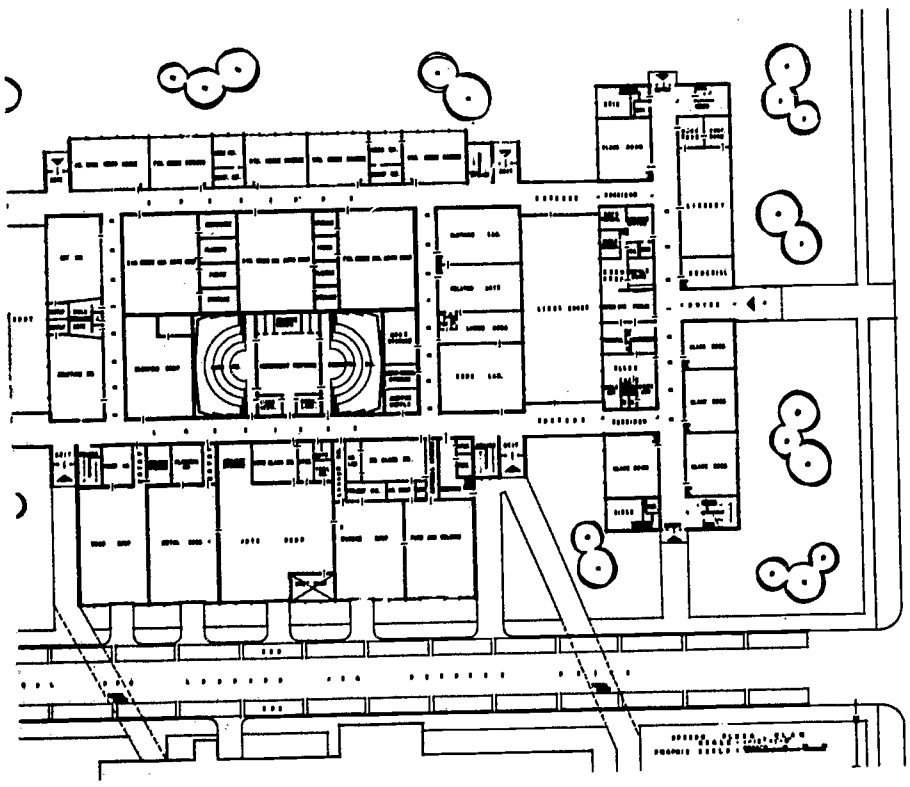
*Construction Cost:*
**$1,654,000 or $11.82 per sq. ft.**

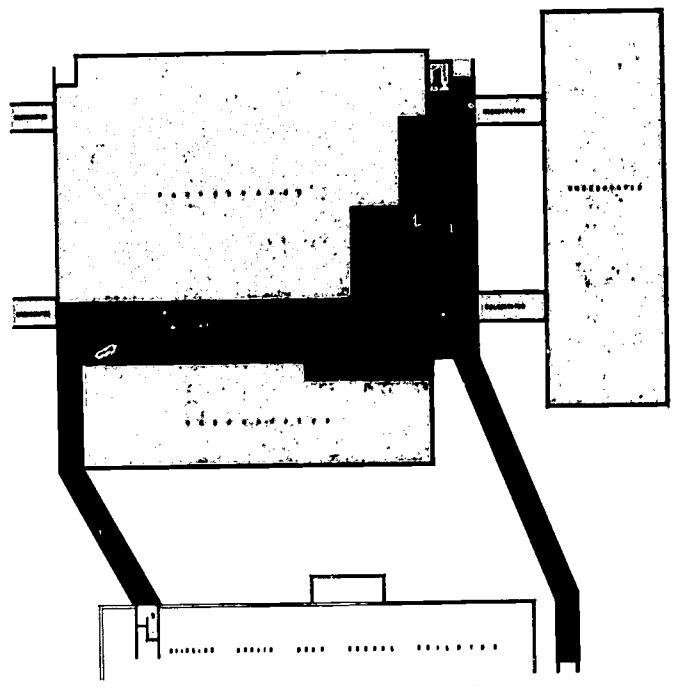
*Shelter Cost:*
**None—inherent in basic design**

*Shelter Area:*
**15,240 sq. ft.**

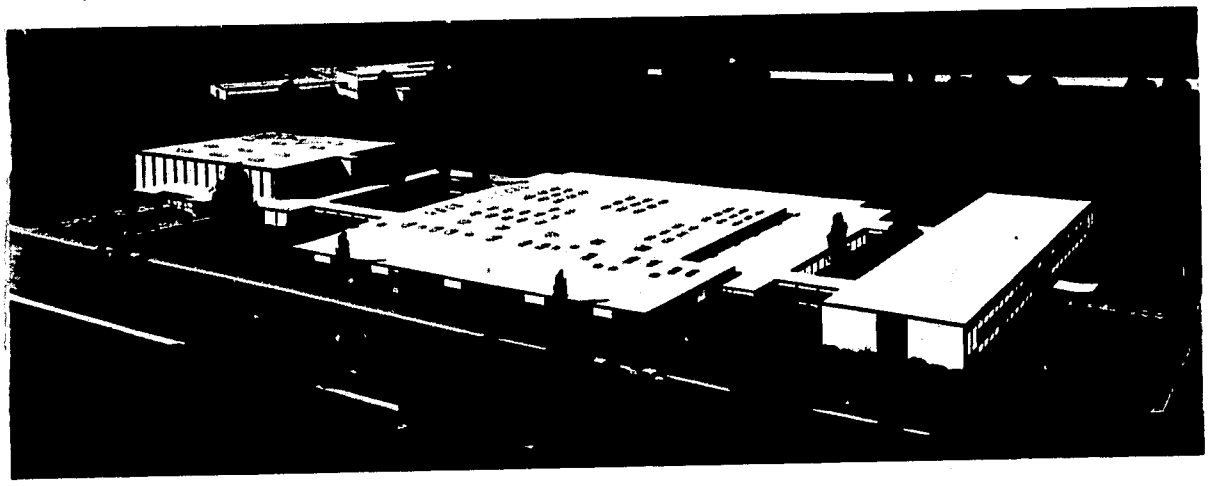


**Ground Floor Plan**





**Basement Floor Plan**



**Exterior Perspective**

## Ledyard High School

**Ledyard, Connecticut**
**Lyons and Mather, AIA, Architects**
**Bridgeport, Connecticut**

The underground fallout shelter area incorporated in this school provides a flexible dual-use space. In addition to providing fallout protection, the area can be used as a small-group assembly room, for music practice, for secondary physical education and for such highly special projects as a rifle range. As a shelter it has a capacity of 1,100 persons.

The shelter area, located underneath the gymnasium locker room, is walled on four sides with reinforced concrete. The stories above it are enclosed by heavy masonry walls with minimum window openings. Two stair towers on opposite sides of the shelter area provide access and are protected by masonry baffles.

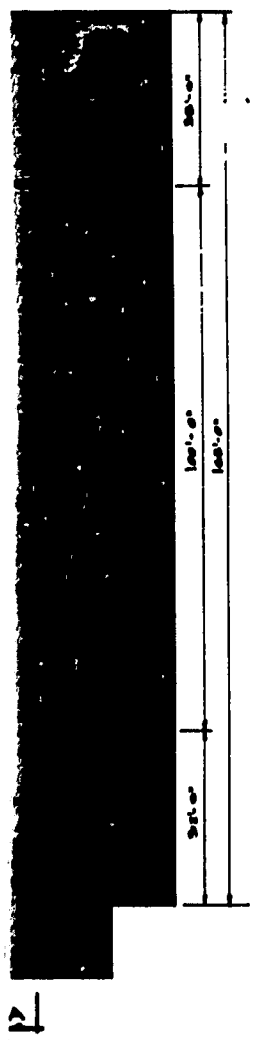
Sanitary facilities for the shelter area are in line with the locker room facilities above, and emergency systems assure adequate ventilation and power.

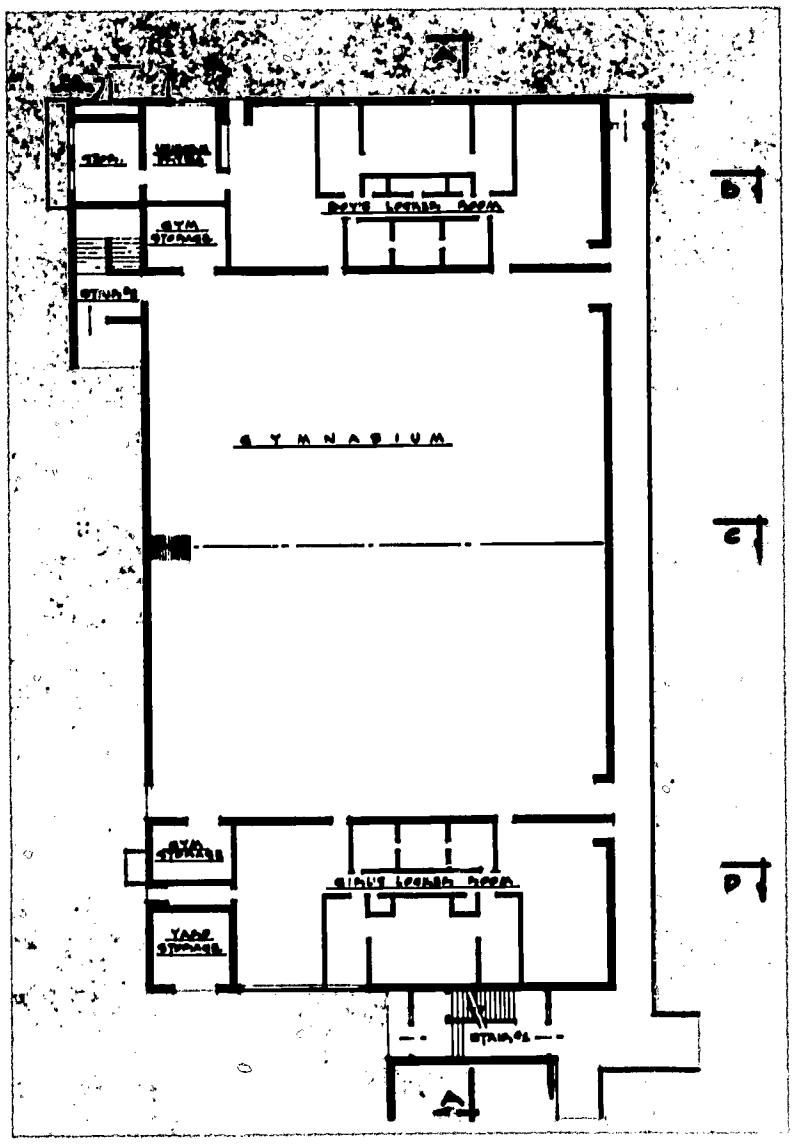
*Construction Cost:*
**$1,227,960 or $13.35 per sq. ft.**

*Shelter Cost:*
**$34,500 or $0.38 per sq. ft. of school area**

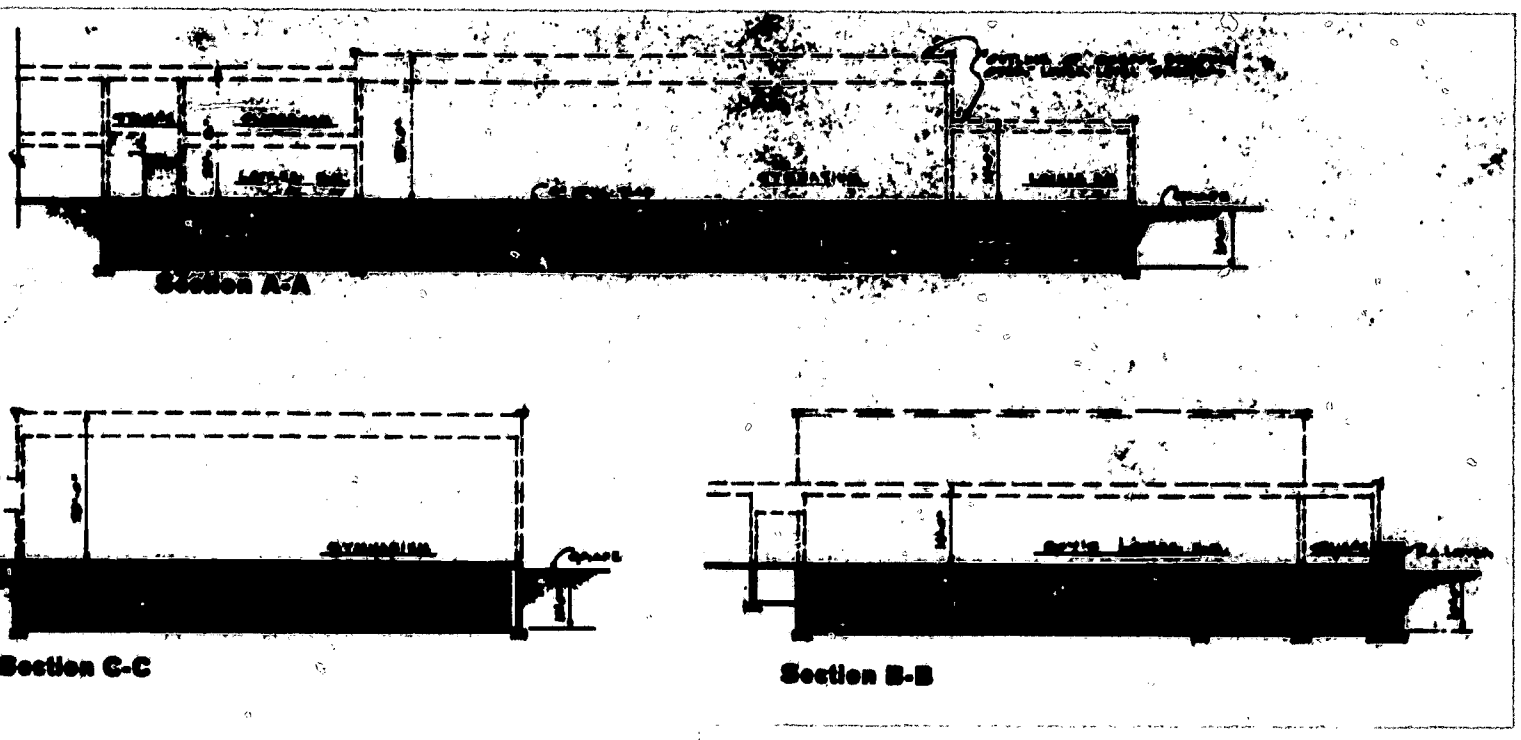
*Shelter Area:*
**15,000 sq. ft.**

**Lower Level Plan**






Upper Level Plan



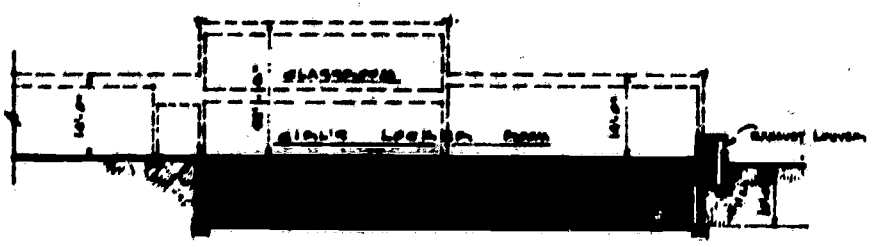
Section A-A



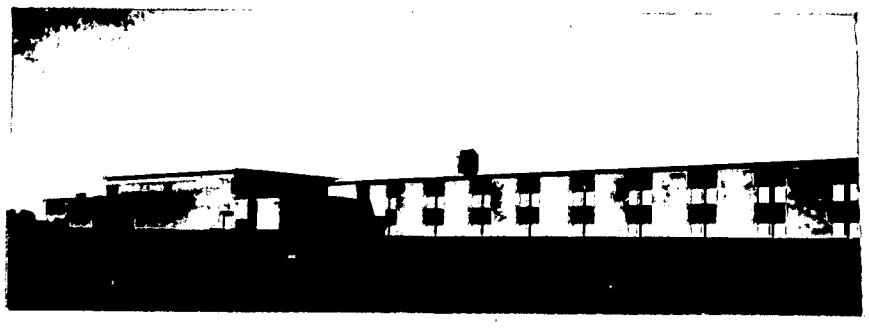
Section C-C

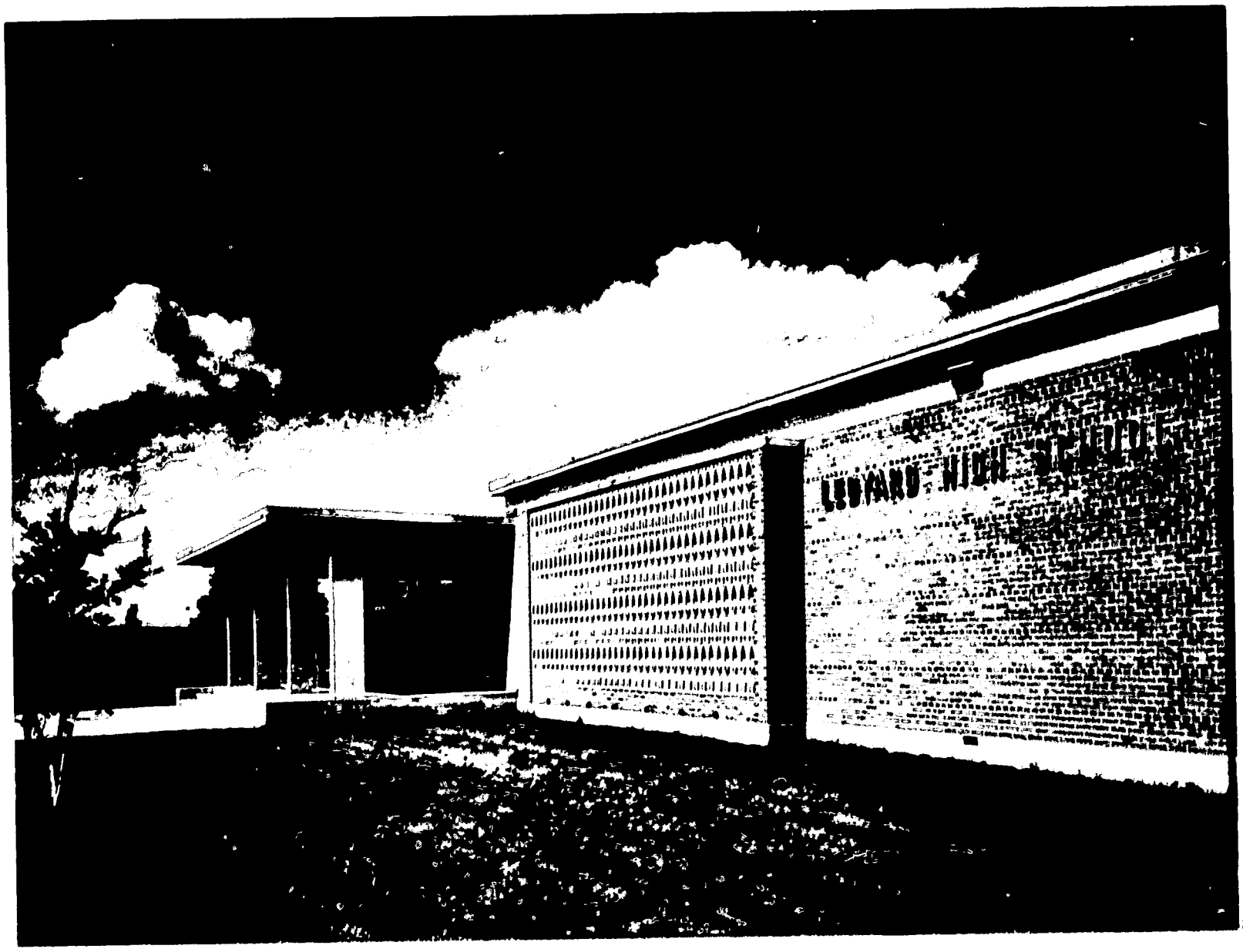


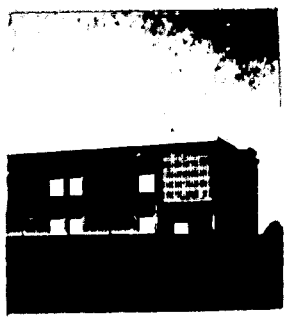
Section B-B



Section D-D







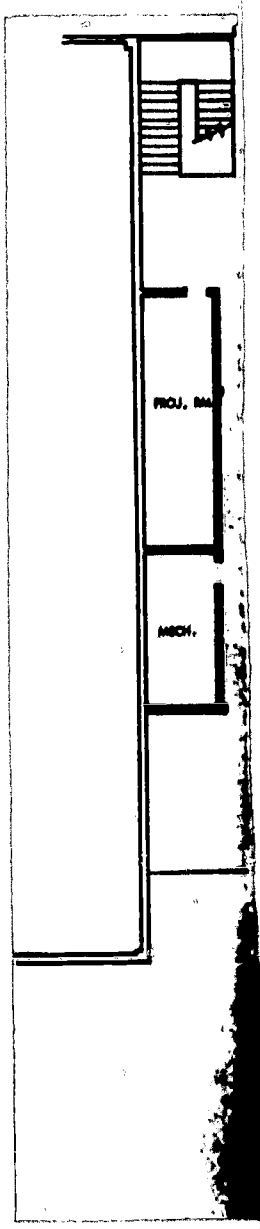
## Denis J. O'Connell High School Auditorium

**Arlington, Virginia**
**T. J. Collins and Son, Architects**
**Staunton, Virginia**

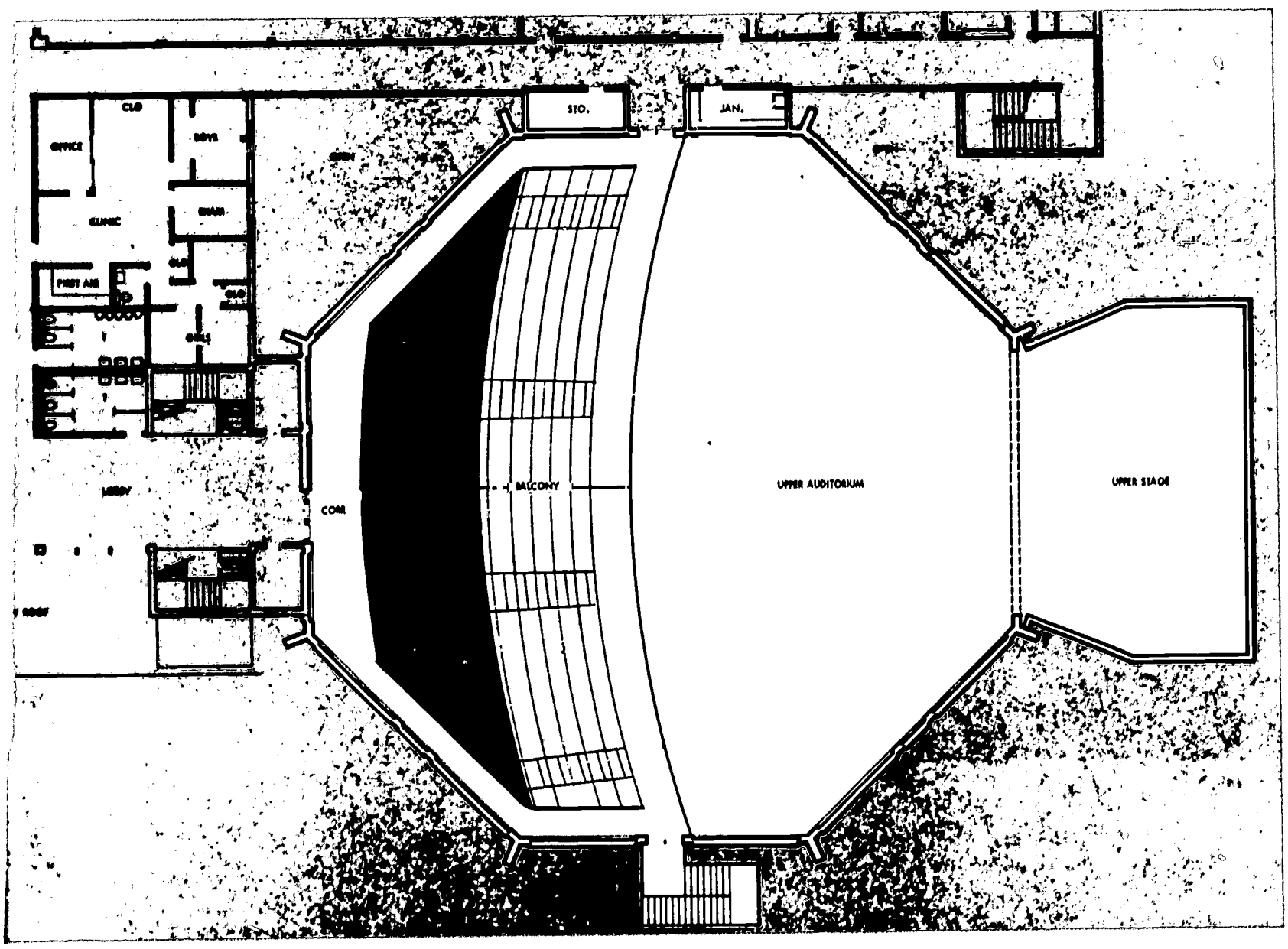
Recently, an auditorium was added to an existing building on this high school campus. The air-conditioned auditorium is essentially a two-story, windowless masonry structure and contains seating space for approximately 1,600 persons.

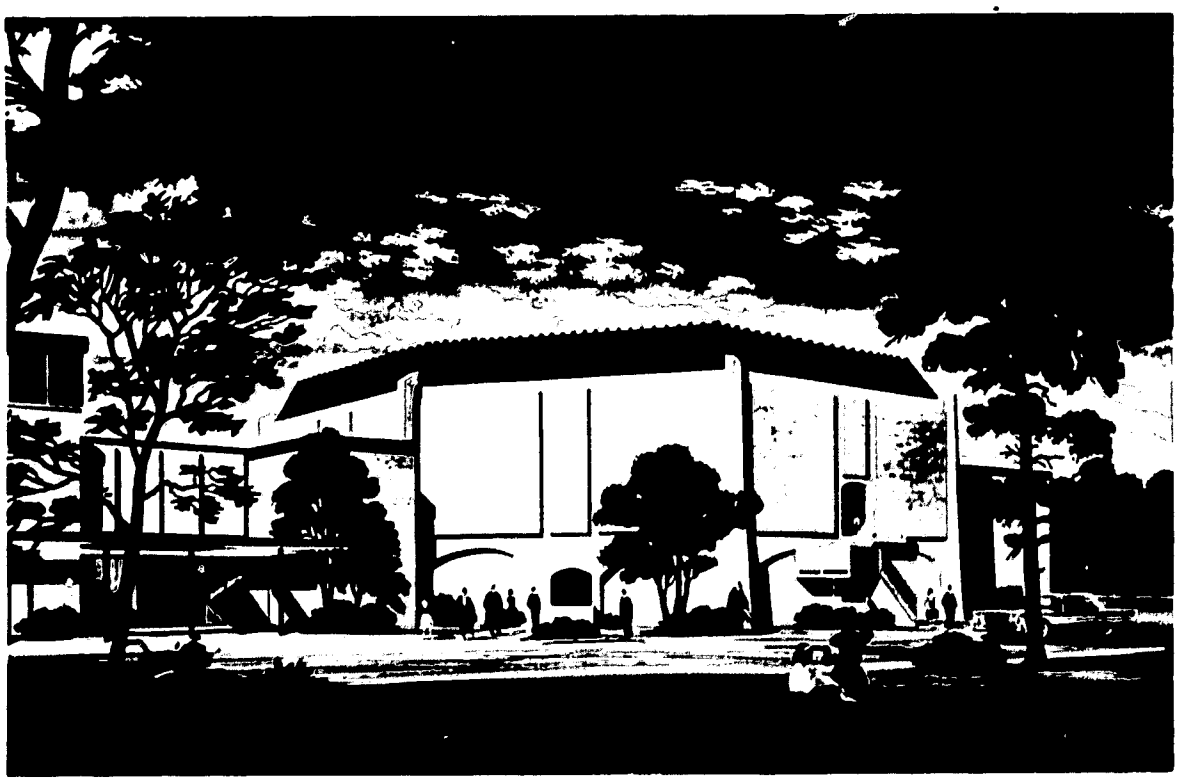
A concrete balcony containing approximately 500 seats provides overhead fallout protection to the occupants at the rear of the auditorium on the lower level. Additional shelter space is located in the storage and dressing room areas beneath the auditorium stage.

*Construction Cost:*
**$900,000**
*Shelter Cost:*
**None—inherent in basic design**
*Shelter Area:*
**Approximately 5,000 sq. ft.**

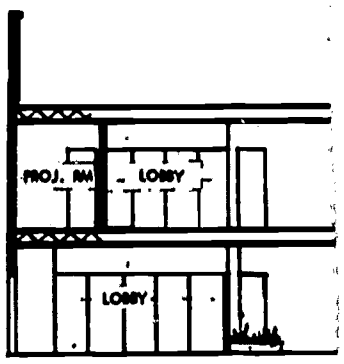



**Floor Plan**


CLO
OFFICE
BOYS
CLINIC
GIRLS
FIRST AID
STO.
JAN.
BALCONY
UPPER AUDITORIUM
UPPER STAGE
COAT



Exterior Perspective

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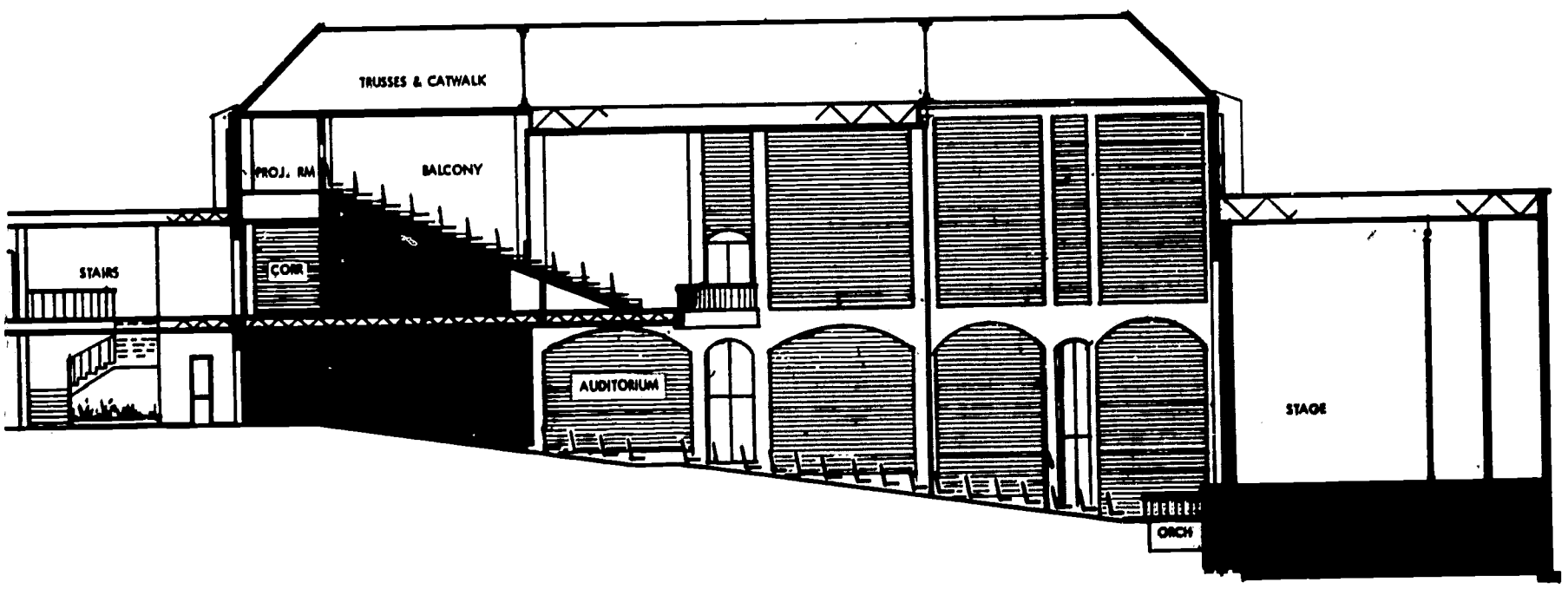

TRUSSES & CATWALK
PROJ. RM
BALCONY
STAIRS
CORR
AUDITORIUM
STAGE
ORCH

## Miami Senior High School

**Miami, Arizona**
**Bricker and Hoyt, AIA, Architects**
**Phoenix, Arizona**

Provision of fallout protection was a significant element in the initial planning of this senior high school complex, which consists of two classroom buildings—both two stories high—and separate structures for an auditorium, gymnasium, administration office, cafeteria and materials center.

Fallout protection was achieved through the use of slanting techniques in overall construction. Precast concrete T-beams were used in roofs, and exterior walls are of masonry construction with a minimum of windows.

Shelter areas in the auditorium and gymnasium buildings provide protection for approximately 3,100 persons. Additional shelter spaces are provided in the first and second floor corridors of the two classroom buildings through the use of masonry corridor bearing walls, concrete slabs over the corridors and screen walls at the exterior entrances to the corridor.

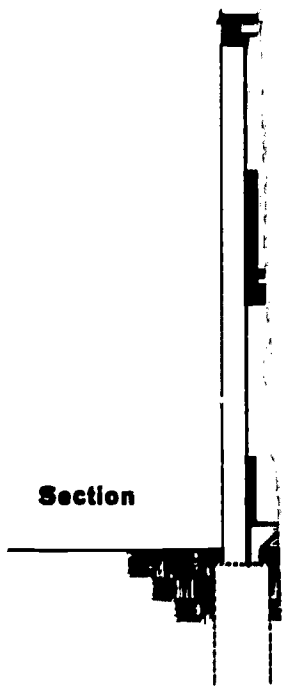
*Construction Cost:*
**$1,764,000 or $14.00 per sq. ft.**

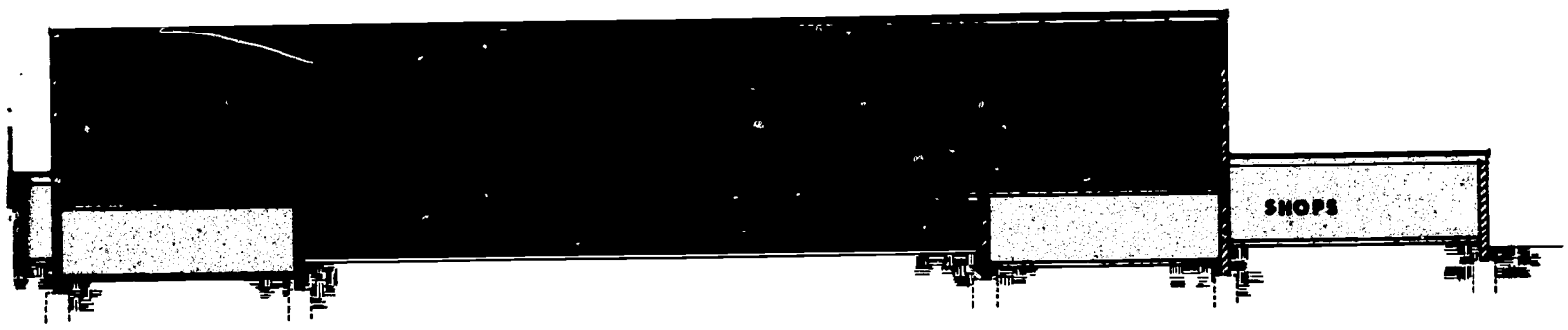
*Shelter Cost:*
**None—inherent in basic design**

*Shelter Area:*
**39,680 sq. ft.**

**Section**


**Section**

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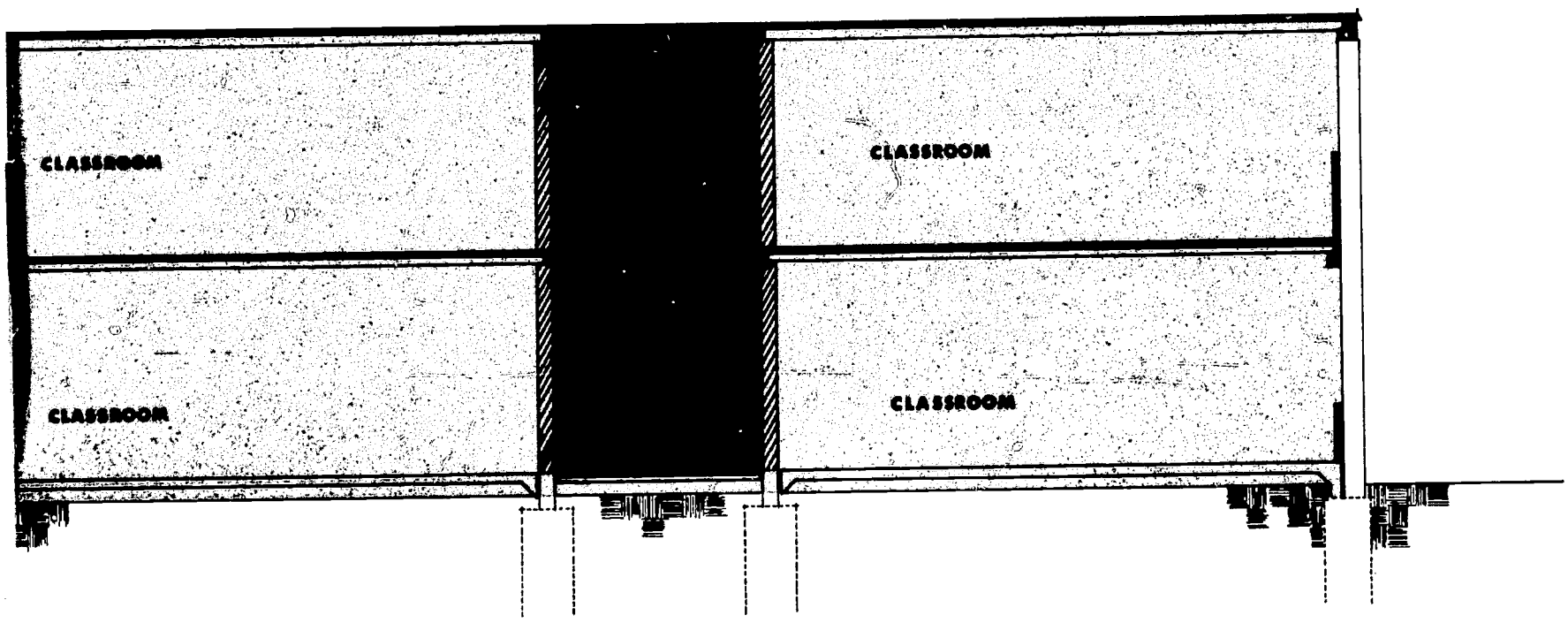
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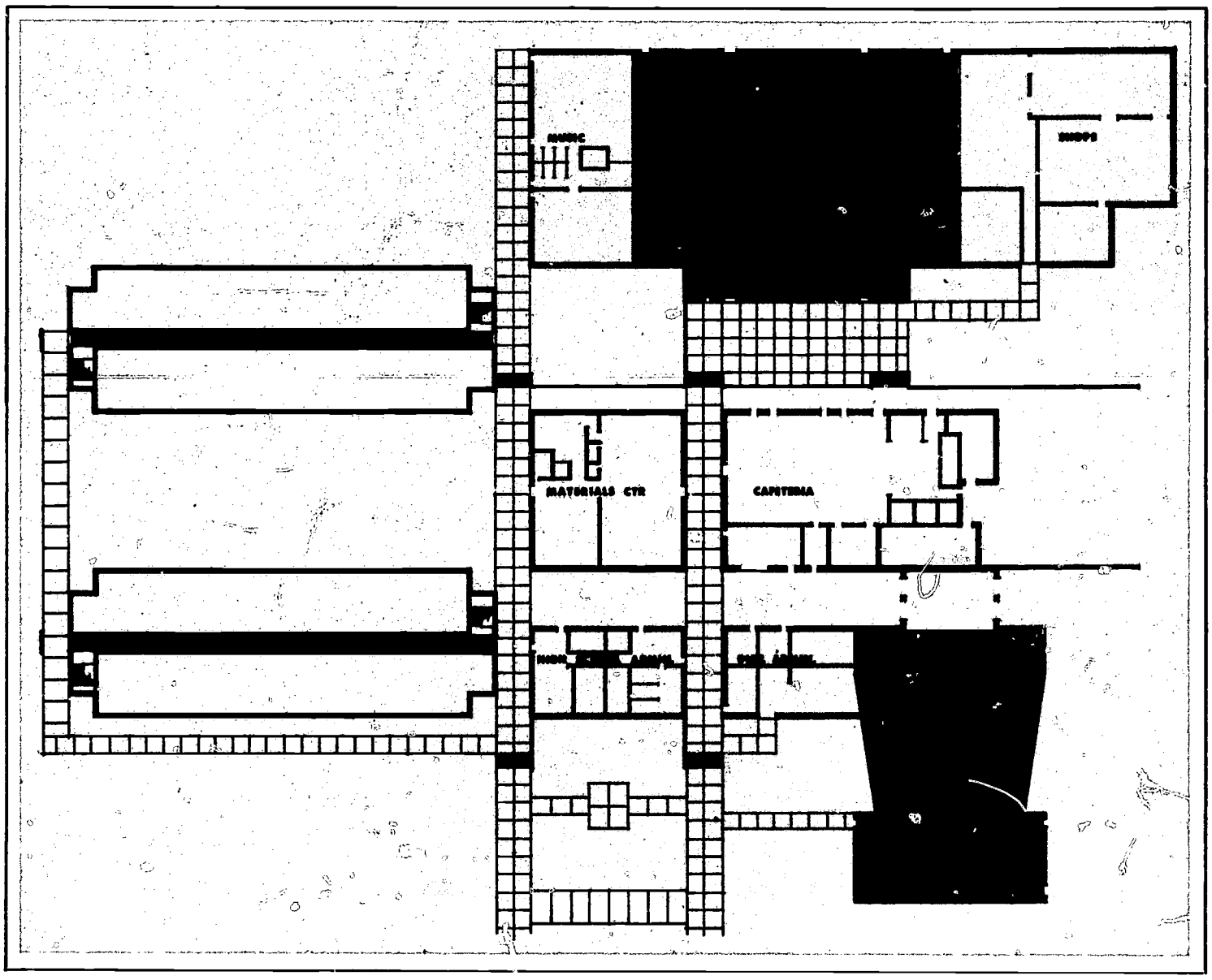
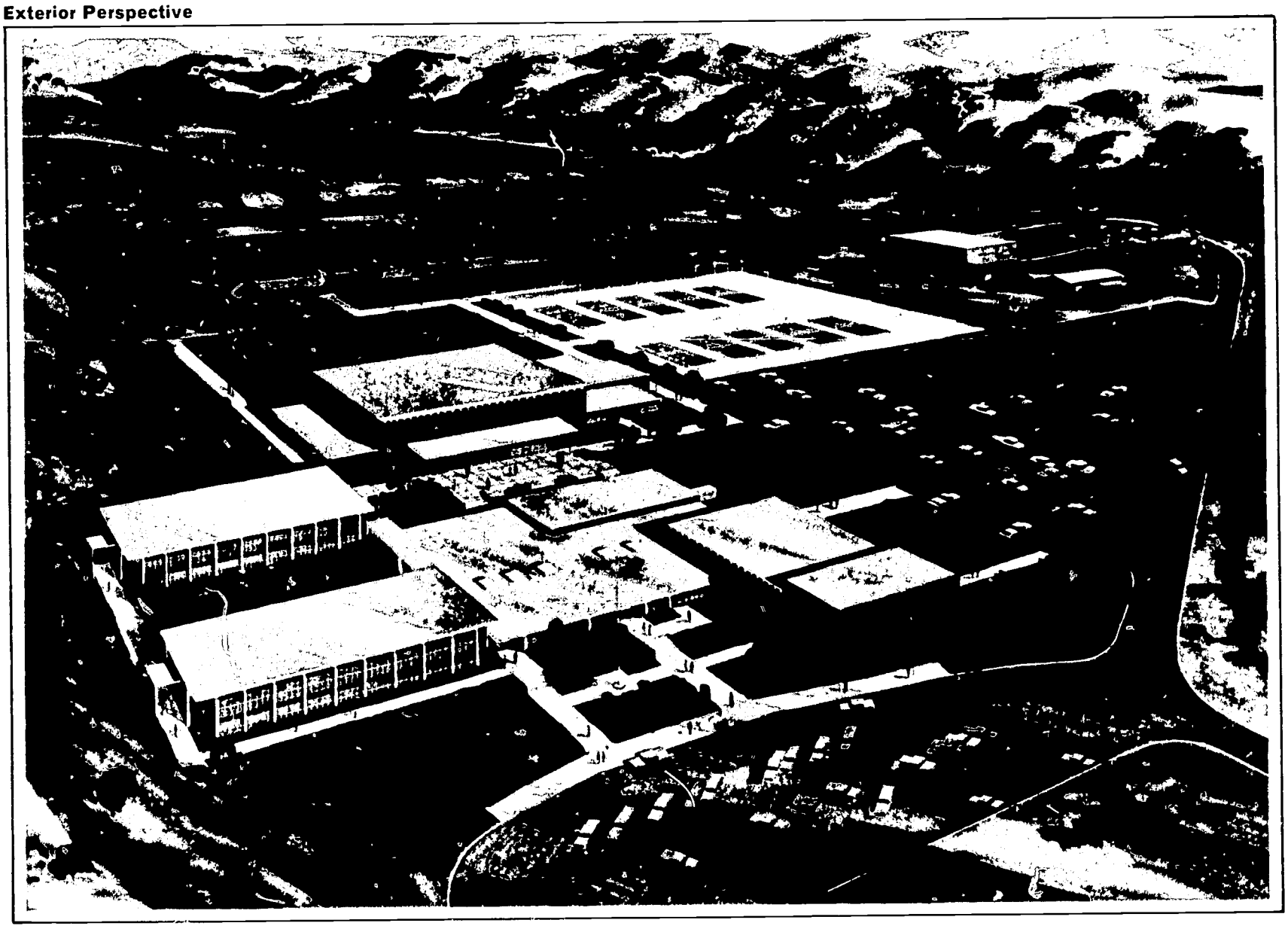



Floor Plan

**Exterior Perspective**



## Somers Elementary School

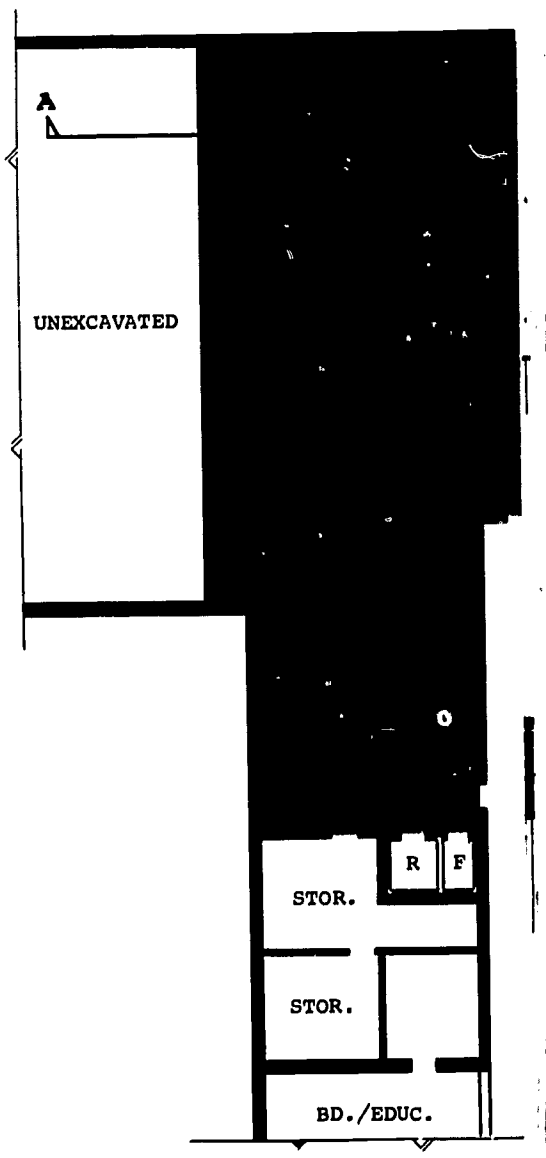
**Somers, Connecticut**
**Sherman R. Patterson, Architect**
**A. George Mallis, Engineer**
**Thurston W. Munson, Associate Architect**
**Springfield, Massachusetts**

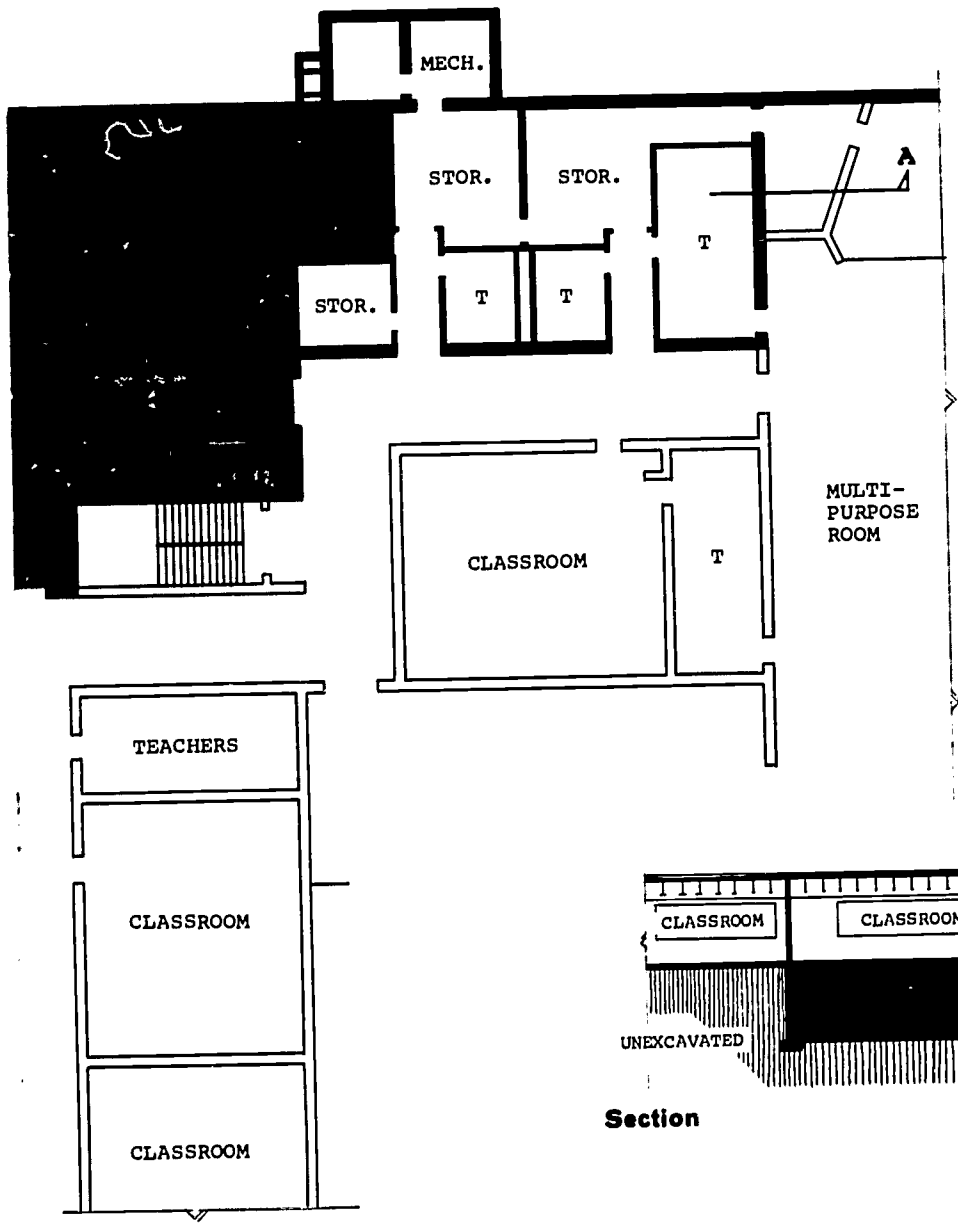
This two-story school is a steel-framed, masonry building designed for 600 students. The school is scheduled for completion in June, 1966. Most of the building is aboveground, with classrooms located on both levels of the school. Because the school is on a sloping site, the east wall of the cafeteria (located on the ground floor) is actually below ground. The cafeteria, kitchen, toilets and storage areas are fallout protected and can accommodate an estimated 700 shelterees. An 8-inch reinforced concrete slab on steel beams provides overhead protection for the shelter area.

The proximity of the school to a major Air Force Base prompted the school board to include fallout protection in the structure. The designers were also able to provide up to 10 pounds per square inch of blast resistance for the shelter.

*Construction Cost:*
**$780,400 or $14.22 per sq. ft.**
*Shelter Cost:*
**$14,500 or $0.26 per sq. ft. of school area**
*Shelter Area:*
**Approximately 7,100 sq. ft.**

**Floor Plan**

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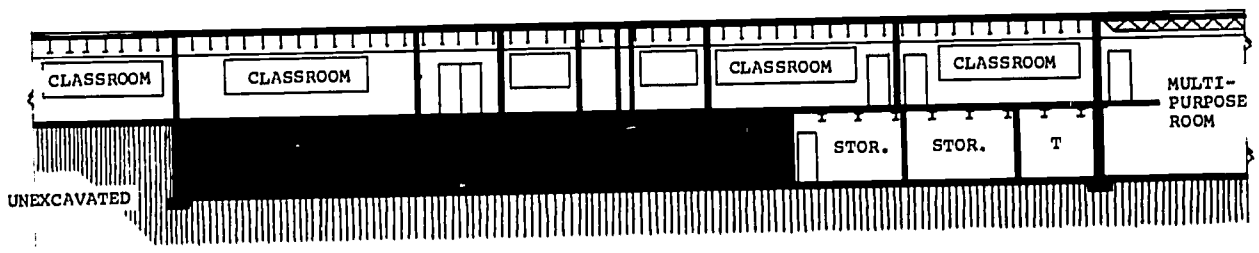
CLASSROOM


CLASSROOM
CLASSROOM
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MULTI-
PURPOSE
ROOM
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UNEXCAVATED

**Section**

## Miami Springs Senior High School

**Miami, Florida**
**Watson, Deutschman and Kruse, AIA, Architects**
**Miami, Florida**

The primary construction features, providing the inherent shelter capability in this 2000 student school, are the reinforced concrete structural system and the minimal use of windows. The concrete structure of roof and second floor combine to provide ample barrier material overhead. Considerations of both initial cost and operating economy dictated the use of relatively small windows, in this completely air-conditioned school.

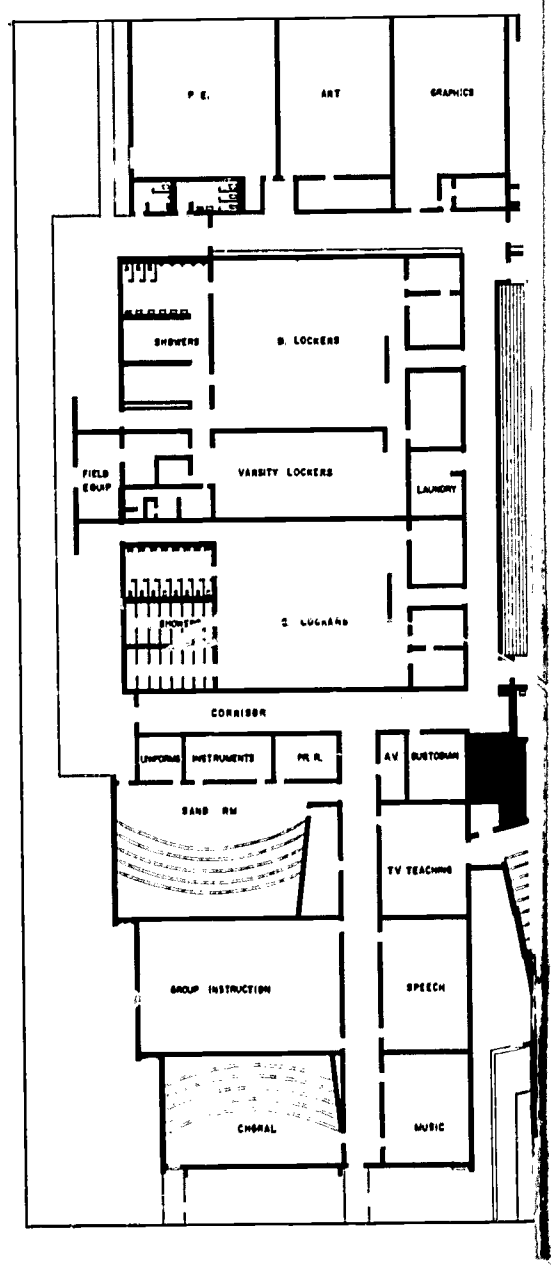
Protection from hurricanes and severe tropical storms made provisions of shelter desirable quite apart from the potentials of nuclear hazards. Awareness of dangers, from both natural and man-made sources, has influenced the design in this case. The protective features have been incorporated as dual-use space most subtly, without sacrifice of asthetic or functional values.

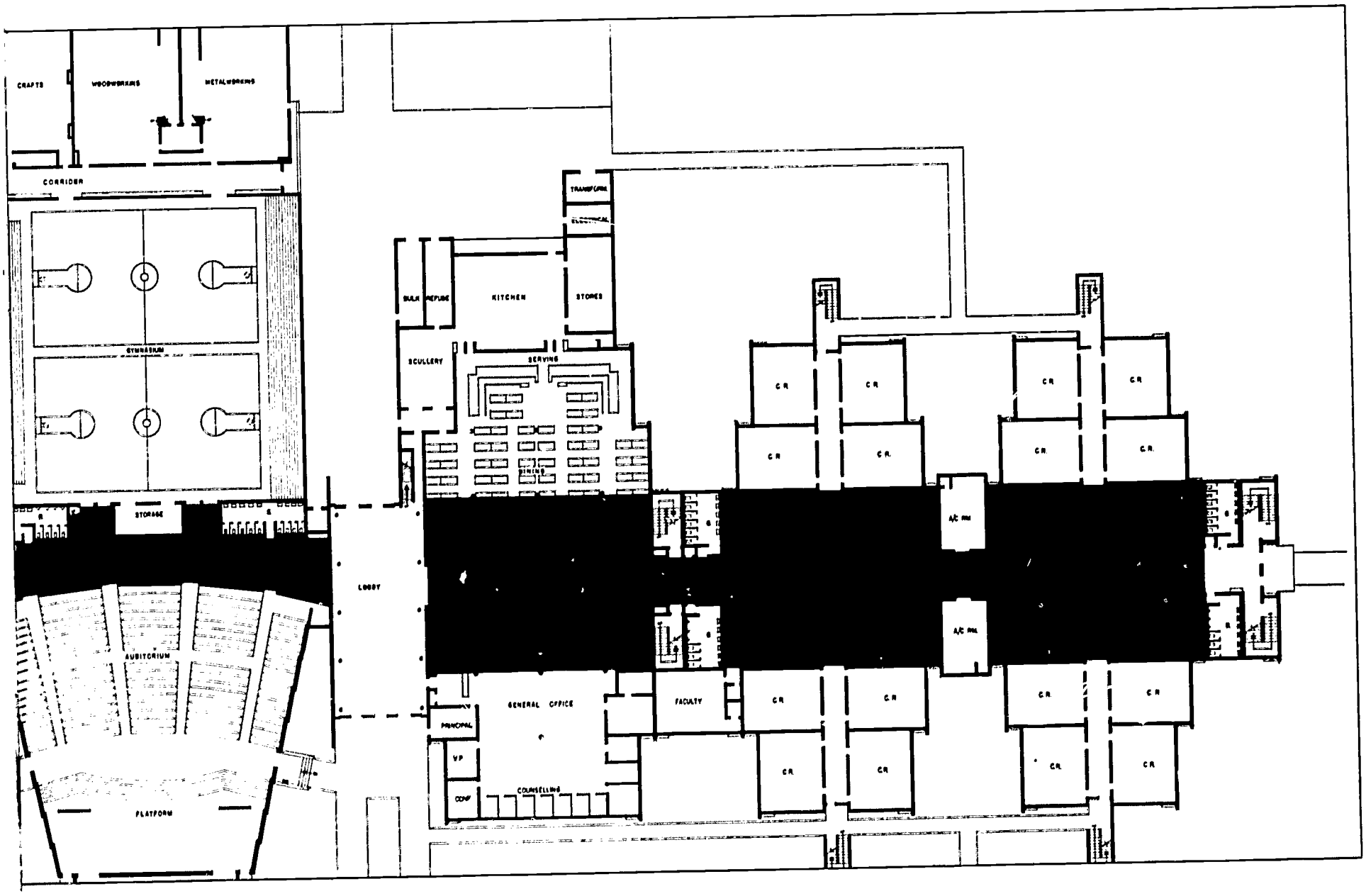
*Construction Cost:*
**$2,167,700 or $12.62 per sq. ft.**

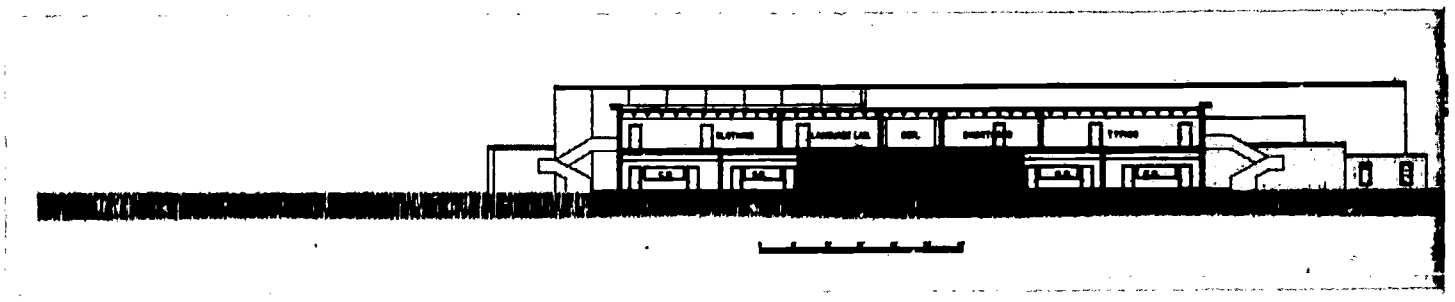
*Shelter Cost:*
**None—inherent in basic design**

*Shelter Area:*
**Approximately 18,000 sq. ft.**

**Ground Floor Plan**

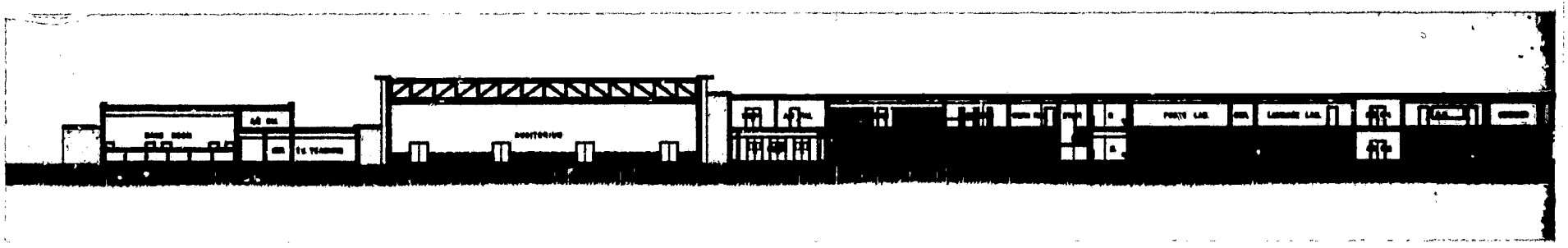


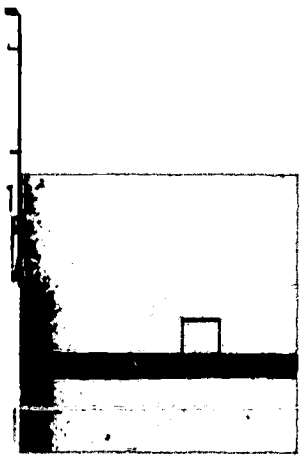

CRAFTS
WOODWORKING
METALWORKING
CORRIDOR
GYMNASIUM
STORAGE
AUDITORIUM
PLATFORM
LOBBY
TRANSFORM.
ELECTRICAL
BULK
REFUSE
KITCHEN
STORES
SCULLERY
SERVING
DINING
GENERAL OFFICE
PRINCIPAL
VP
COMP
COUNSELLING
FACULTY
C.R.
A/C mn

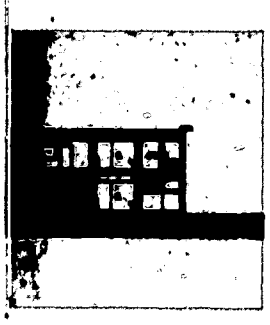


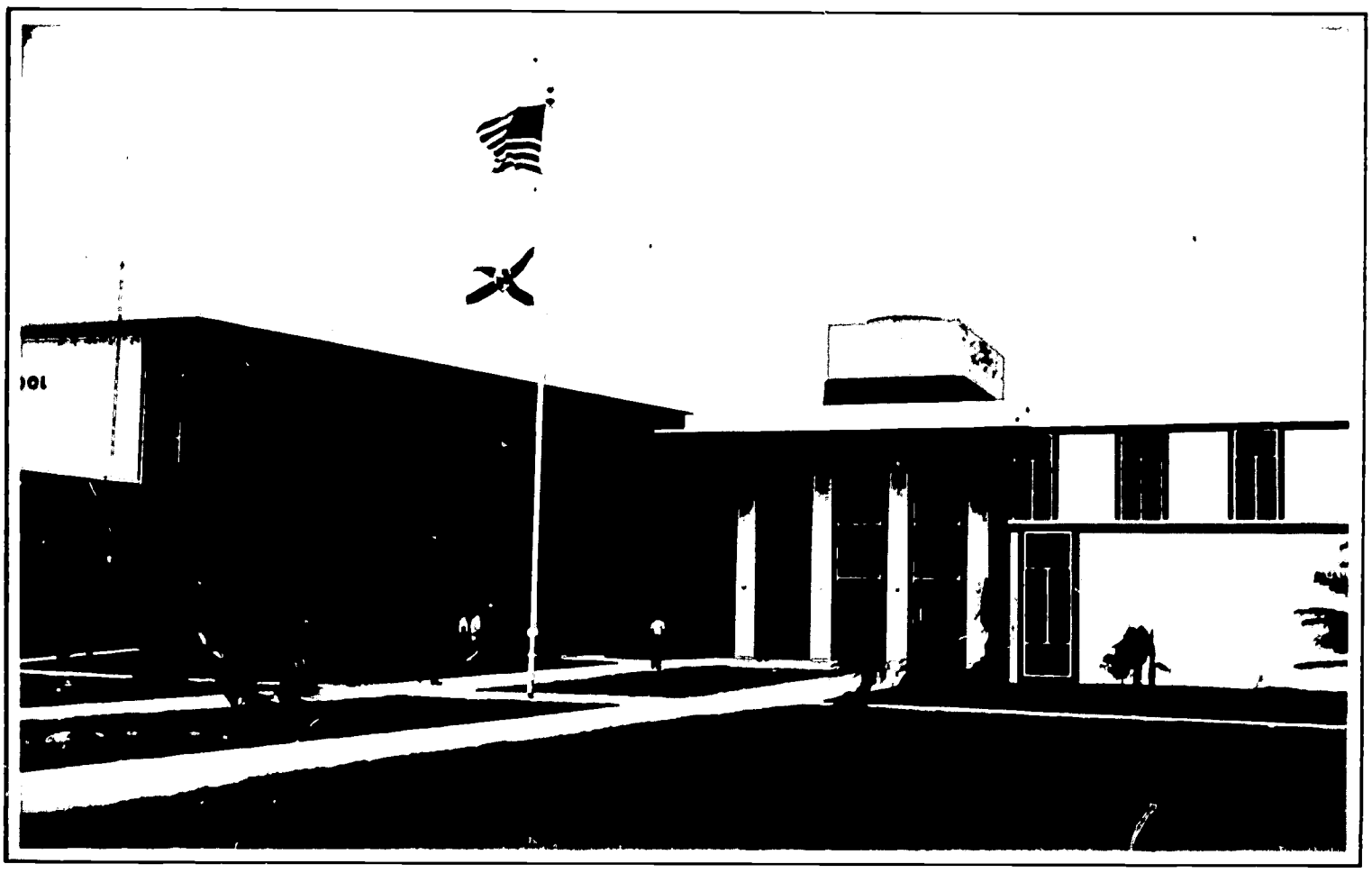
**Section**

**Section**









## "SLANTING" TECHNIQUES

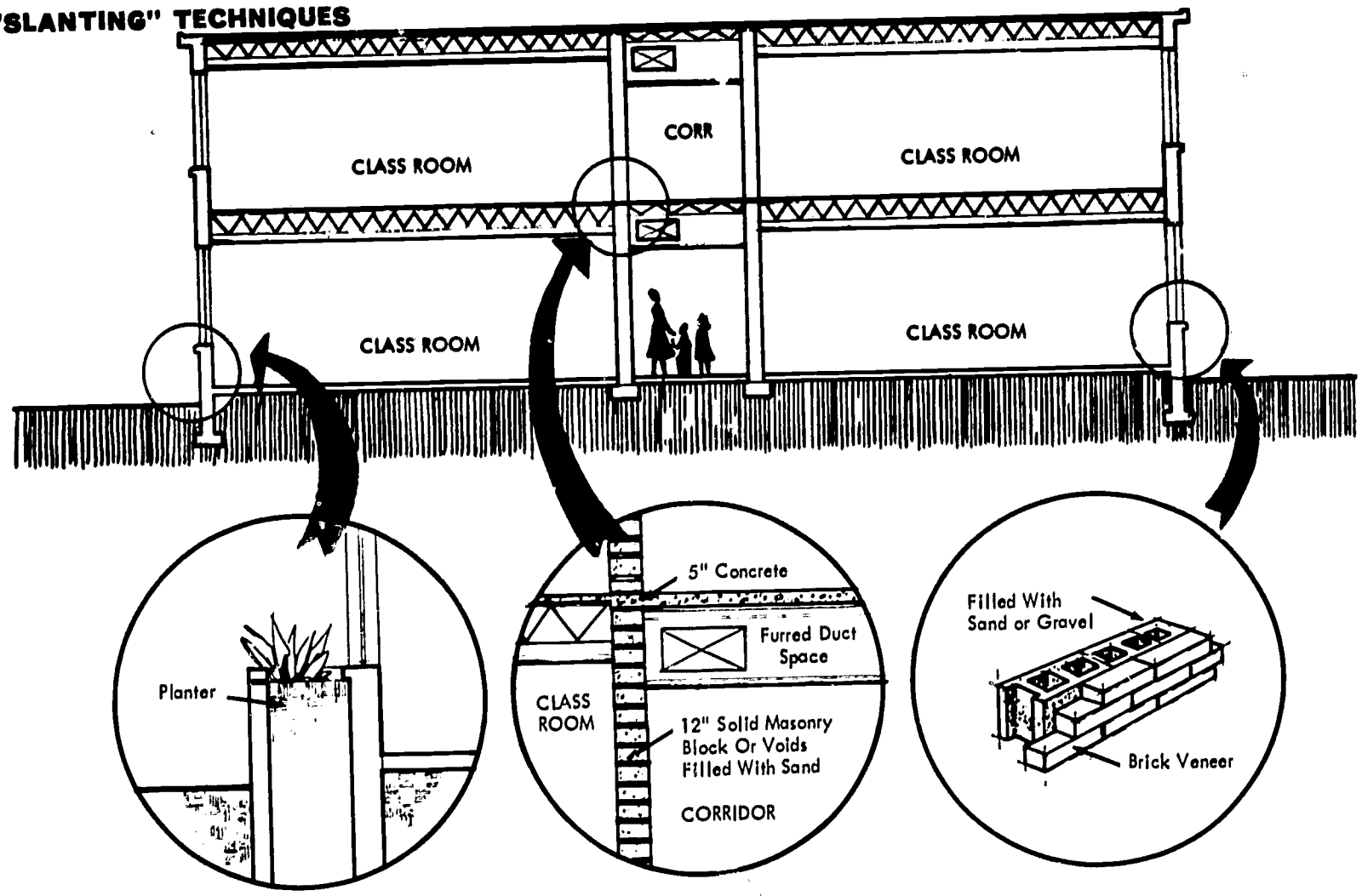
Every building, to some extent, provides a natural shield against fallout radiation. Some buildings, however, are better than others. In the National Fallout Shelter Survey, millions of suitable shelter spaces were found in existing buildings, even though no consideration had been given to fallout protection when they were first designed and built. Many other buildings would have provided reasonable protection, but they had weak points which nullified otherwise good protection. If such weak points 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 for little, if any, increase in cost. The incorporation of fallout protection in this manner is called "slanting."

Examples of slanting are: reducing window areas and raising sill heights; judicious use of retaining walls and planter boxes; grading slope away from building; partially depressing buildings into the ground; arranging building modules to provide a protected core; and filling hollow walls with sand or gravel. The school buildings depicted in this booklet have utilized some of these "slanting" techniques and many other protective approaches.

Over 10,000 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" techniques to maximize 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 schools and universities throughout the country.

The examples presented confirm that inexpensive dual-use fallout protection can be incorporated into schools without detracting in any way from the beauty or usefulness of the building. In many cases, the shelter protection was inherent in the school design and achieved at no increase in cost.

## "SLANTING" TECHNIQUES



END

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For distribution to:

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OCD Regions

Defense Coordinators of other Federal Agencies

Qualified Fallout Shelter Analysts

Architects and Engineers Attending a Fallout Shelter Analysis Course

CE—BuDocks Field Offices

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And Others

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