5-1 General

This chapter describes space organization principles that may be employed in the development and review of designs. A principle is defined here as a rule exemplified in the organization and layout of a building design. In order to provide guidance on how individual spaces and design elements go together, space organization principles are expressed (and illustrated) as typical rules. Such rules may describe how individual spaces go together to form functional areas, and how functional areas go together to form a building design. Spaces must generally be organized to allow for the development of economic structural and mechanical systems, future facility expansion, multi-use and security. Site constraints and amenities, requirements for safety and use by the physically handicapped will also affect the organization of space in a building design. These factors can generally be described in terms of rules to be employed during the design process.

5-2 Functional Layout Principles

A. Individual Space Relationships.

(1) Spaces must be organized to provide optimum adjacency relationships. Table 5-1 indicates by means of four categories of proximity the required spatial compatibility of each type of space in the service school. The four categories of proximity are defined below, and Table 5-1 provides a list.

a. Adjacent.

It is essential that the two spaces share at least four feet of common wall so that direct access can be provided.

	Conference Classrooms	laboratory Classrooms	Instructional shops	Self-Paced Classrooms	Computer-Aided Instruction Classrooms	Seminar Classroom	Auditorium/ Theater	Instructor Preparation	Instructor Rehearsal	Counseling Offices	Remedial Instruction	Technical Library	Study Areas	Projection Room	Administrative offices	Conference Rooms	Student Lounge	Snack/ Vending Rooms	Bookstore	Restrooms	Janitor	Storage
Conference Classrooms																						
Laboratory Classrooms	40																					
Instructional Shops	55	55																				
Self-Paced Classrooms	45	45	55																			
Computer-Aided Instruction Classrooms	45	45	55	40																		
Seminar Classroom	40	40	55	45	45																	
Auditorium/Theater	45	45	55	45	45	45																
Instructor Preparation	45	45	55	40	40	40	45															
Instructor Rehearsal	55	55	55	55	55	55	55	55														
Counseling Offices	40	40	55	40	40	40	45	40	55													
Remedial Instruction	40	40	55	40	40	40	45	40	55	40												
Technical Library	40	40	55	40	40	40	45	40	55	40	40											
Study Areas	45	45	55	40	40	45	45	40	55	40	40	40										
Project Room	40	X	X	X	X	X	40	X	X	X	X	X	X									
Administrative Offices	40	40	55	40	40	40	45	40	55	40	40	40	45	X								
Conference Rooms	45	45	55	40	40	45	45	40	55	45	45	45	45	X	45							
Student Lounge	45	45	45	40	40	45	45	45	55	45	45	45	45	X	45	45						
Sncak/Vending Rooms	55	45	45	45	45	55	55	45	55	45	45	45	45	X	55	55	X					
Bookstore	55	55	45	55	55	55	55	55	55	55	55	55	55	X	55	55	40	40				
Restrooms	45	40	40	45	45	45	45	45	55	45	45	45	45	X	45	45	45	40	40			
Janitor	45	45	45	45	45	45	45	45	55	45	45	45	45	X	45	45	45	40	40	40		
Storage	45	45	45	45	45	45	45	45	55	45	45	45	45	X	45	45	45	40	40	40	X	

Table 5-1
Functional Affinity Matrix

b. Near Forty.
It is essential that the borders of the two spaces be nearer than 40 feet from each other; equivalent to a 10 second walk.

c. Near Four Hundred Eighty.
It is essential that the borders of the two spaces be nearer than 480 feet from each other; equivalent to a 2 minute walk.

d. Near One Thousand Nine Hundred Twenty.
It is essential that the borders of the two spaces be nearer than 1920 feet from each other; equivalent to an 8 minute walk.

(2) Spaces must be organized to result in as compact a facility as possible. To promote maximum efficiency, the service school must be designed to be as compact as possible. In particular, related activities must be located in close proximity to one another. A compact facility increases efficiency in several ways:

a. It decreases circulation time between classes.

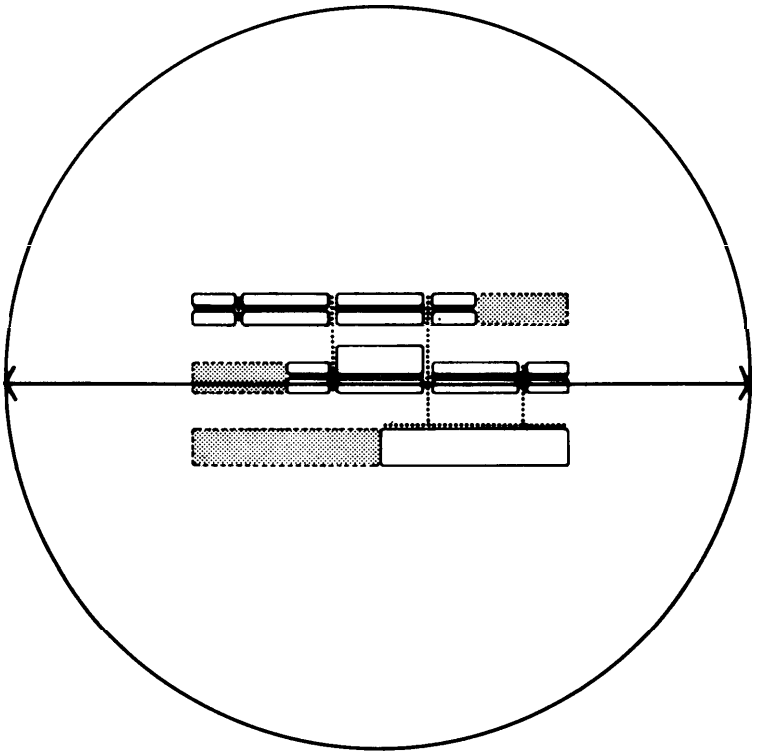
b. It facilitates adapting the school's operation to changes in instructional programs.

c. It facilitates operations during period of mobilization by enabling the school to adapt readily to the extremely tight scheduling requirements of mobilization training.

d. It typically results in lower operating costs than a more dispersed facility with the same floor space and makes more efficient utilization of energy resources.

(3) Instructional spaces must be planned so that none are further than an eight minute walk from each other.

a. Schools must be planned so that distances between primary instructional areas are reasonable. Assuming 10-minute breaks between classes, 8 minutes of actual circulation time, and an average walking speed of 4 feet per second, students can walk approximately 1,920 feet during class breaks. In a 2-story building, approximately 30 seconds may be required to ascend or descend stairs. This decreases the amount of time available for horizontal circulation, so that the maximum walking distance is reduced to 1,800 feet. A 3-story building could require the student to spend another 30 seconds in vertical circulation, thus further reducing the maximum walking distance to 1,680 feet.



Diameter of Planning Circle:
1920 Feet for Single Story Buildings
1800 Feet for Two Story Buildings
1680 Feet for Three Story Buildings

Figure 5-1
Walking Distances and School Planning

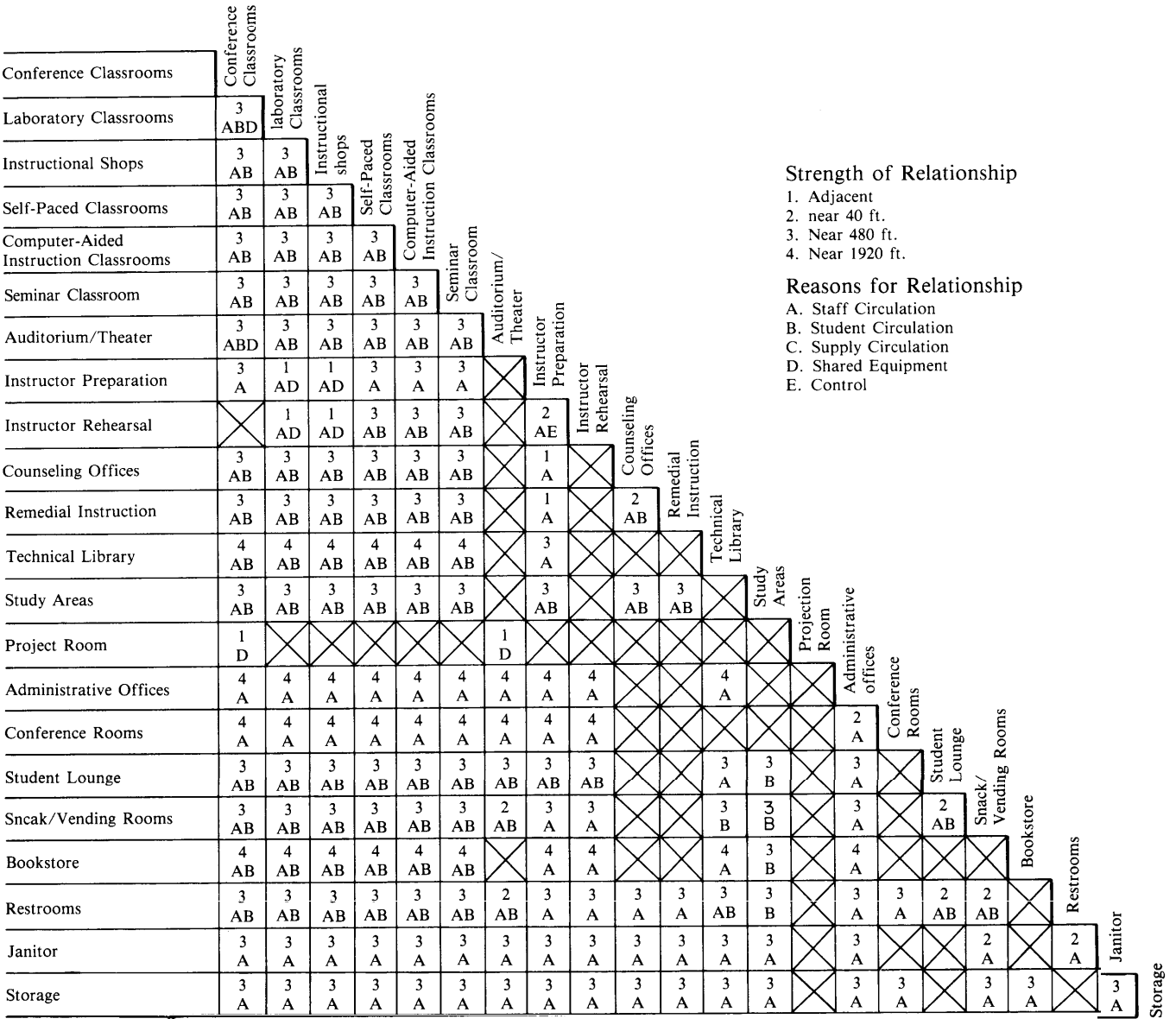
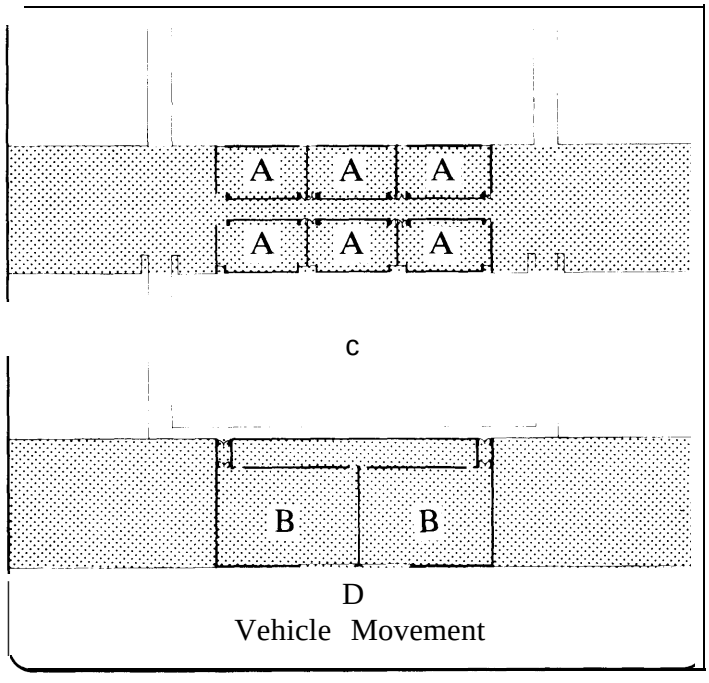


Table 5-2
Suggested STC Ratings for Acoustic Separation

b. A high-rise school building (more than four stories) would normally be serviced by elevators designed to move 80% of the occupants vertically during the peak class change period. Although high-rise buildings are normally very compact, inclusion of a high-rise in an otherwise low-rise school complex may considerably reduce the allowable maximum walking distance.

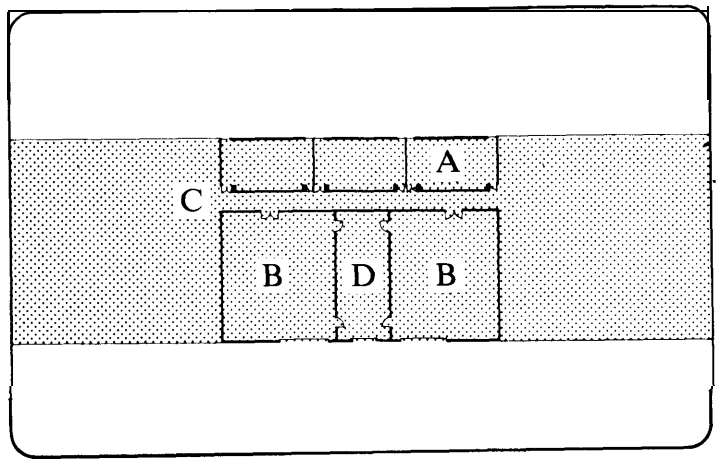
c. Walking distances define the diameters of circular planning areas for service school facilities. Potential expansion of schools must also be programed to take place within the limits of these orginal planning areas. (Figure 5-l). Of course, planning a facility within one of these areas does not guarantee that the maximum walking distances will not be exceeded; it is still necessary to plan circulation routes to be as direct as possible.

(4) Space organization must consider acoustic separation in relation to adjacency of functions. The noise produced by many school activities and training equipment must be attenuated if acceptable noise levels are to be maintained in instructional areas. The acoustic separation matrix (Table 5-2) converts noise level data into acoustic separation criteria. These criteria may be met in a variety of ways. Shops and classrooms, for example, should be in close proximity but not intermixed; they should be separated by sufficient open space (Figure 5-2), by corridors (Figure 5-3), or by a combination of corridors and storage

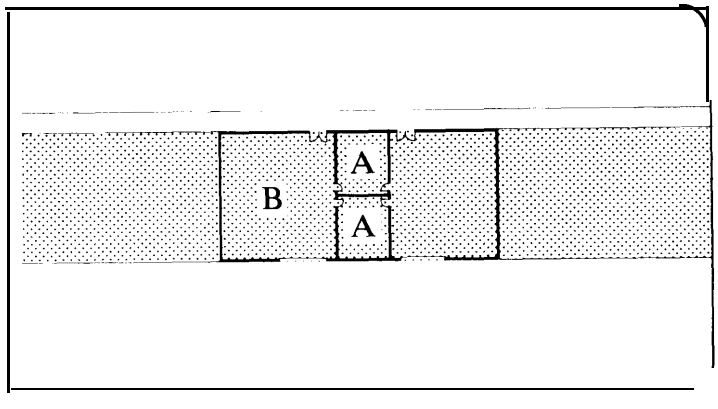


A Classroom
B Shop Areas
C Open Space
D Noise

Figure 5-2
Open Space Separation of Class and Shop Areas.

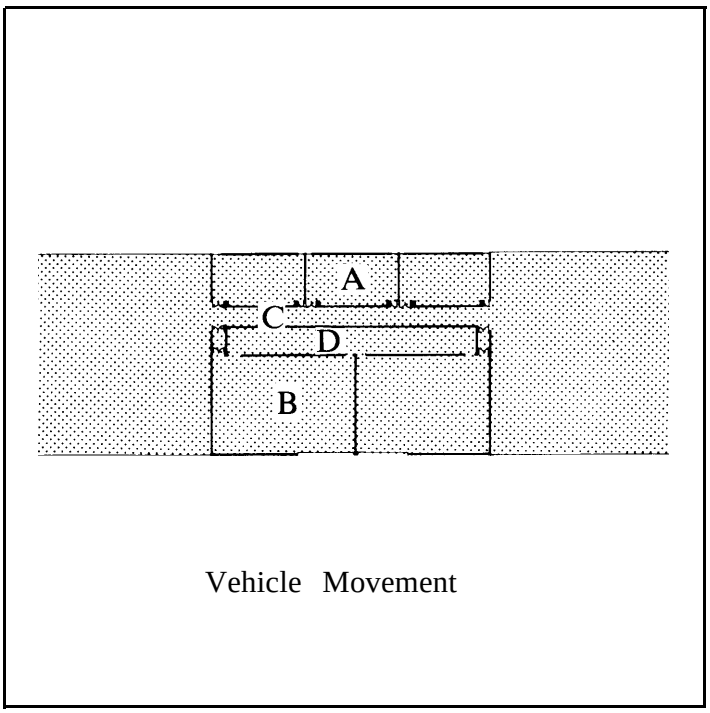


Correct:
A Classrooms
B Shops
C Corridor
D Storage



Wrong:
A Classroom
B Shops

Figure 5-3
Corridor Separation of Class and Shop Areas.



A Classrooms
B Shops
C Corridor
D Storeroom

Figure 5-4
Corridor and Storage Separation of Shop and Class Areas.

areas (Figure 5-4). This employment of open space, corridors, and storerooms as acoustic barriers between shops and classrooms, when combined with appropriate sound control construction, will normally satisfy the acoustic separation criteria.

B. Functional Area Relationships.

(1) Spaces should be organized to group those with common functions. Zoning school activities by function results in a more flexible and efficient facility. This concept is illustrated in the following comparison of functional organizations:

a. Functional Units.
An organization which zones departments as basic functional units (i.e., departments contain their own independent administrative, instructional, and shop facilities) maximizes convenience for department personnel and students whose classes are conducted by a single department (Figure 5-5). On the other hand, such an arrangement, with its wide dispersal of school facilities, severely limits interdepartmental sharing of activity spaces. Some departments may have empty classrooms, while others are overcrowded; yet the circulation time required for students to travel between departments restricts efficient distribution of the student load over the available space. Furthermore, this type of functional organization presents a difficult transportation problem for students who must take classes from several departments.

b. Functional Groups.
Another functional organization zones activities by function on the school level (i.e., all administrative, instructional, and shop spaces throughout the school are consolidated and each of these major activities is then grouped separately.) (Figure 5-6). This zoning greatly enhances the potential for sharing space, since adjacent departments can easily share activity spaces along their common boundary as the operational situation requires. Usually, good functional zoning requires that all similar activities be grouped together on the school rather than the department level. Careful application of this principle in school planning maximizes flexibility, efficiency of operation, economy and better utilization of fuel resources.

(2) Spaces must be organized to provide a workable and convenient flow of students, staff, materials and equipment.

a. Personnel must be able to enter the building's general use areas and easily find the classroom or building element desired. Routes for handicapped personnel must be equally convenient.

b. Materials and equipment must also flow smoothly within the school (see paragraph 2-4b.(3)).

c. Departments should be situated such that staff have easy access to classrooms, labs and shops. As a

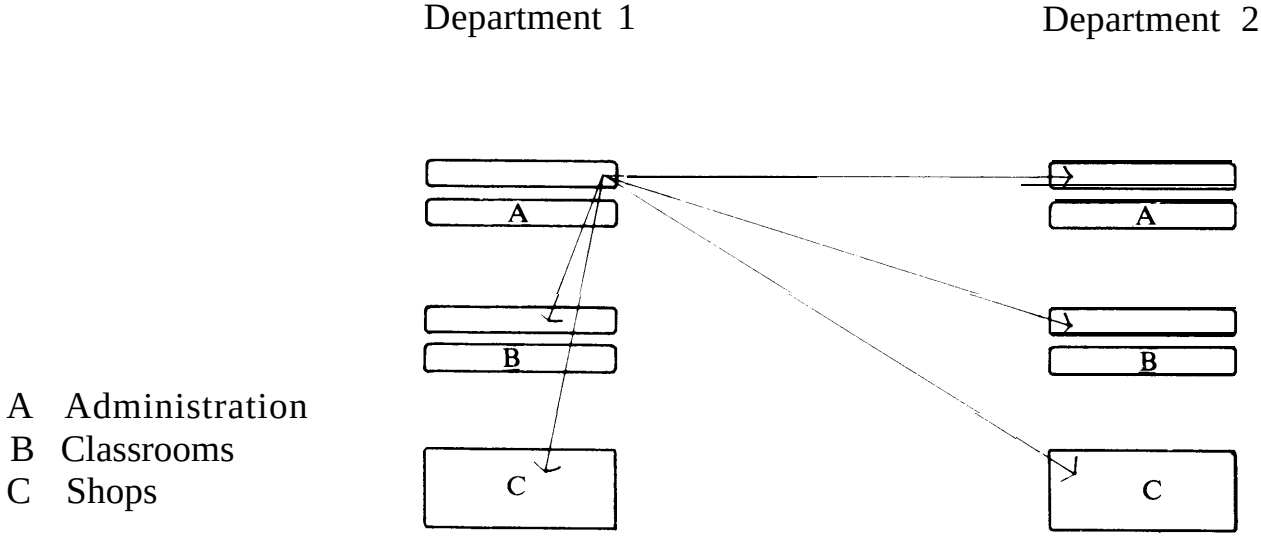


Figure 5-5
Separate Department Organization

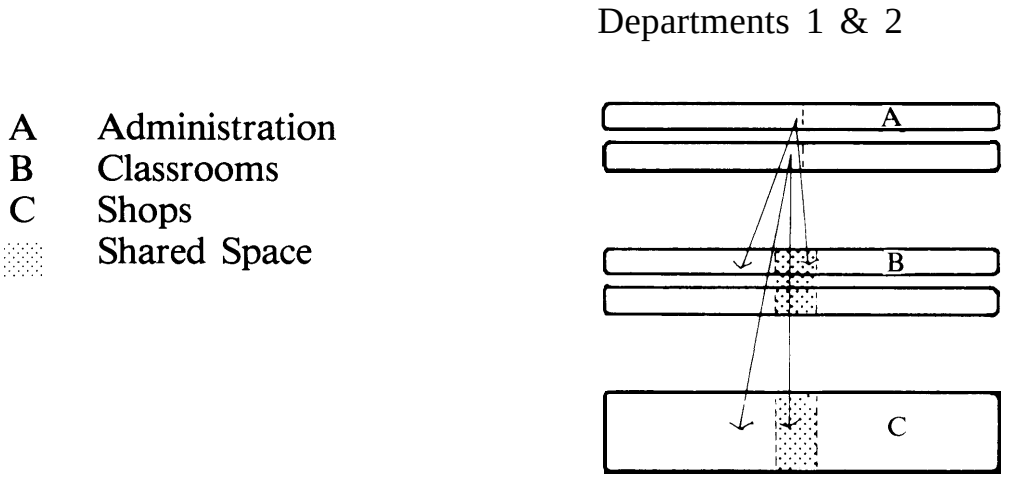


Figure 5-6
Adjacent Departments and Shared Space

general rule, classroom and shop space should be assigned to the departments nearest to it. Instructor access to classrooms is optimized if each resident department is situated along a major circulation route. (Figure 5-7).

d. Most service schools have a requirement for secure areas in which to use and store classified materials. These areas must be planned so that they do not disrupt school circulation patterns by creating dead end corridors. (Figure 5-8).

(3) Loud noise-generating spaces should be consolidated and separated from the rest of the school.

a. Consolidation.
It is more cost effective to contain or reduce sound levels at the source than to provide sound control in all affected spaces. To the extent that it is operationally practical to do so, those items of equipment which produce extreme intensities of sound, such as turbine engines, shall be consolidated and shielded with acoustic insulation materials. They shall be located at sufficient distance from other training areas to allow adequate sound reduction. (Figure 5-9).

A Department A
B Department B
C Department C
D Department D
E Commandant
F Library
G Deputy Commandant for Combat and Training Developments
H Deputy Commandant for Trining and Education

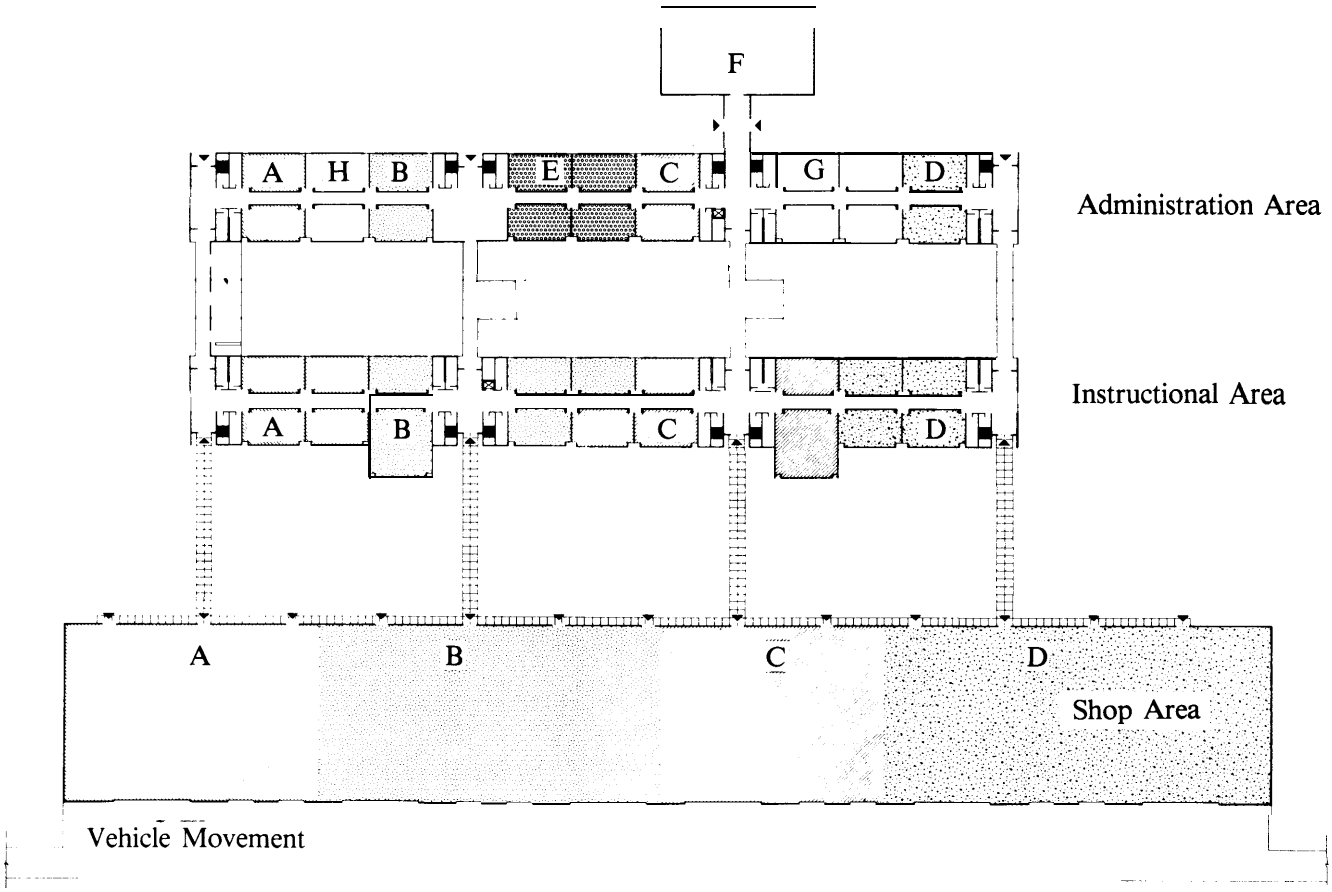


Figure 5-7
Department Locations in School

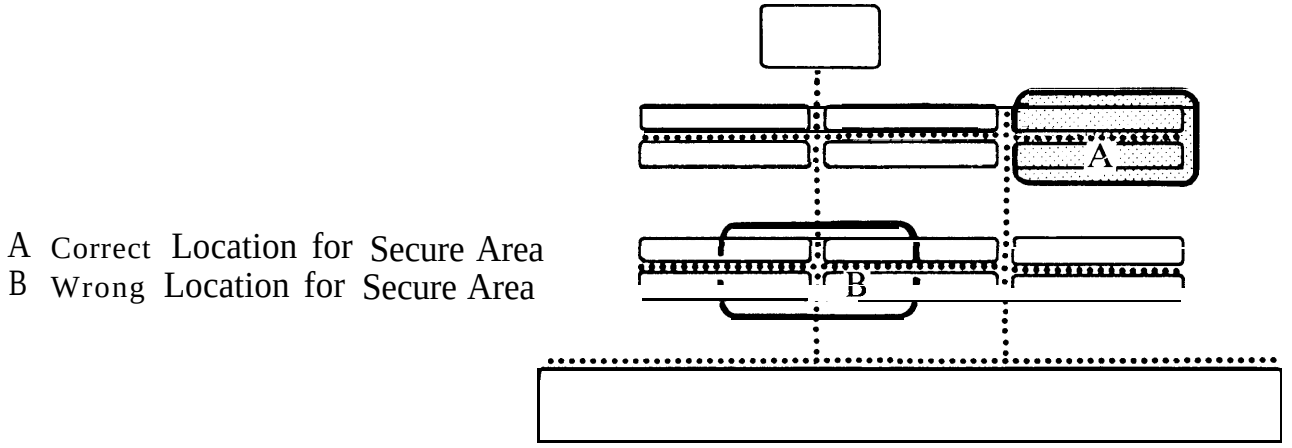


Figure 5-8
Locating Internal Secure Areas.

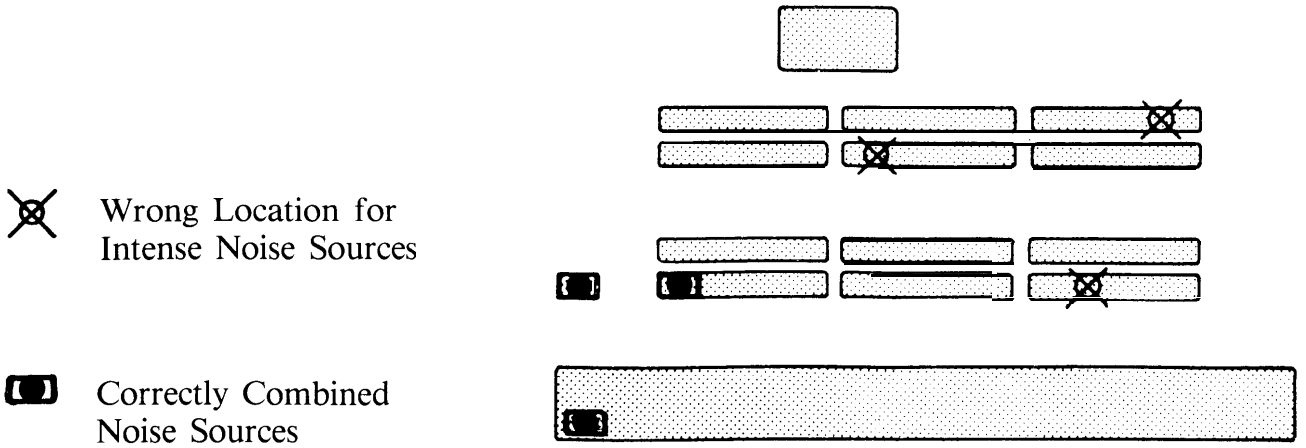


Figure 5-9
Locating Intense Noise Sources.

b. Remote Location.
Dissipation of loud sound requires considerable distance. The intensity of sound energy is inversely proportional to the square of the distance from the source. In other words, doubling the distance from a sound source reduces the level of sound energy received by a factor of four, which is equivalent to a reduction of 6 decibels for each doubling of the distance between source and receiver. The operation of heavy armored or transportation equipment produces between 80 and 120 decibels of sound at a distance of 20 feet. Aircraft may produce in excess of 140 decibels. Assuming 100 decibels at 20 feet, the sound diminishes as follows:

100 db at 20 ft.
94 db at 40 ft.
88 db at 80 ft.
82 db at 160 ft.
76 db at 320 ft.
70 db at 640 ft.
64 db at 1,280 ft.
—
34 db at 40,000 ft. (7 1/2 miles)
etc.

Since 35 decibels is them aximum desired background noise level for classrooms and study areas, it is clear that distance alone is not a practical sound barrier between the classroom environment and related training on loud equipment. Even single glazed windows in a typical building will reduce sound transmission from outside the building by approximately 30 decibels. Therefore with typical school construction disturbing noise sources need to be kept at a distance only great enough to reduce the ambient noise level around school buildings to a level of 65 decibels. Normal construction will filter this level of sound to acceptable classroom levels. In large schools, it may be possible to reduce noise levels by designing to take advantage of interposing terrain features.

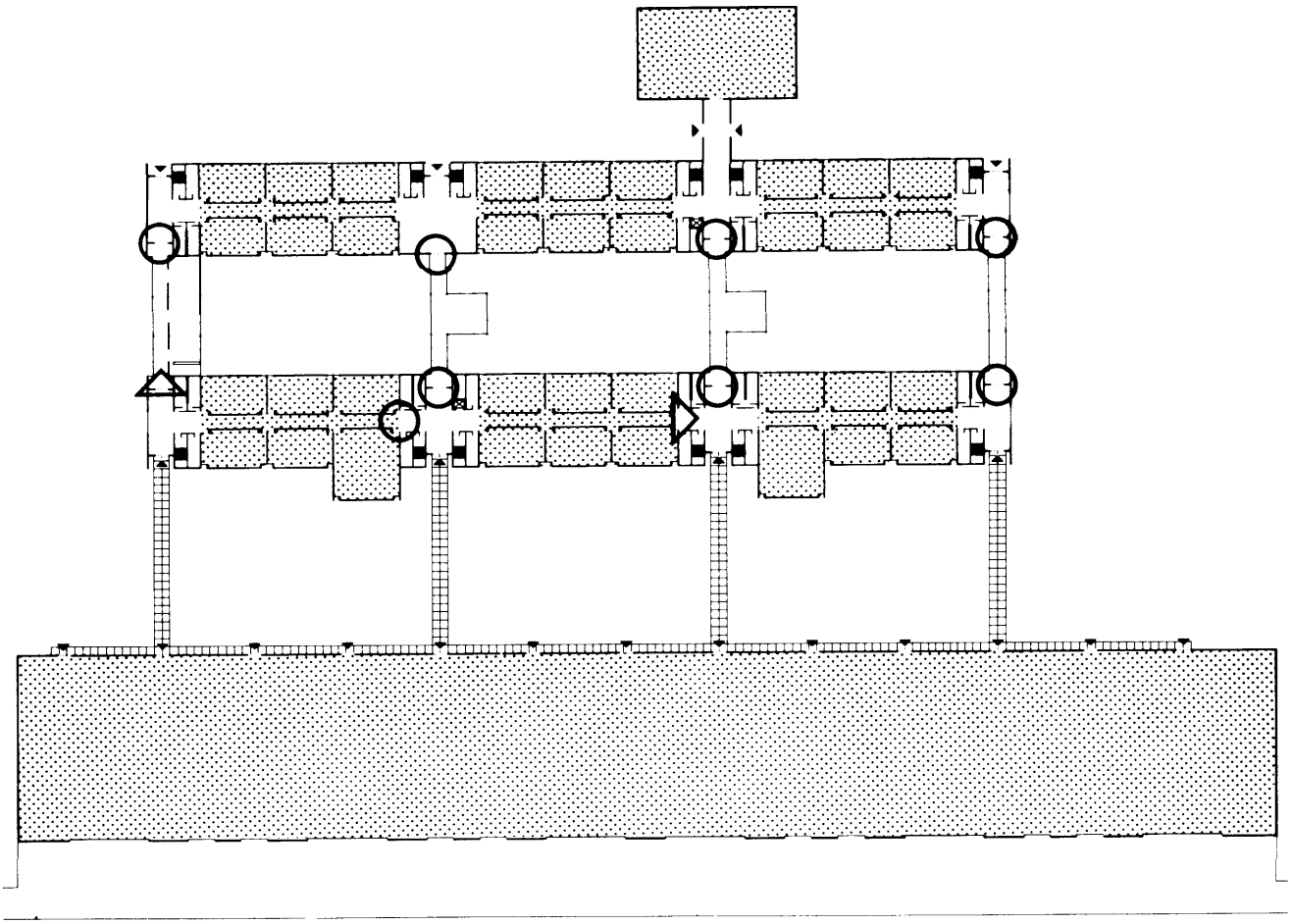
Components of building mechanical and electrical systems, such as HVAC equipment, exhaust fans, transformers and rectifiers, can be sources of excessive noise, especially if located in or near instructional spaces. This noise shall be controlled either by relocating the source outside the instructional area or by interposing sound absorptive materials between the source and the instructional space.

5-3 Structural Layout Principles

A. Modular Spacing Compatibility.

(1) Structural systems should be dimensioned to conform to the standard classroom module. Flexibility and expansibility are the primary criteria for selection of structural systems for service schools. The standard 25 ft. x 30 ft. classroom is the basic module of dimension, as provided in paragraph 3-2b above. A number of structural systems have been specially developed to economically provide these requirements for school buildings.

(2) Spaces must be organized in conjunction with a 5 foot module. In order to utilize school building systems all layout planning for service schools should conform to a 5 foot by 5 foot grid, without bearing walls.



Sound Isolating Doors and Smoke Partition ○

Sound Isolating Doors and Horizontal Exit △

Exterior Entrance/Exit A

Figure 5-10
Internal Corridor Separations

(3) Dedicated and non-modular space must be held to a minimum and consolidated into locations that do not affect the modularity of the remainder of the school.

B. Resistant Construction Zones.

(1) Spaces must be organized to meet fire safety requirements. Fire safety provisions impact strongly on the spatial organization of service schools. Smoke partitions must be provided every 300 feet. The maximum area of each fire area cannot exceed 30,000 square feet. The maximum exit distance is 150 feet, if automatic sprinklers are not provided, and 200 feet if they are provided. These criteria have major implications to the location of exits and intersecting corridors, and to the maximum number of classrooms between them. These, in turn, affect the location and size of latrines, janitor's closets, stairs and other dedicated space. (See paragraphs 24c(2)(e) and 2-4c(7).) Shops, laboratory classrooms, and their storage facilities are required to have one hour fire separation walls and independent exits. This suggests that separate wings or buildings be provided for these facilities (Figure 5-10).

(2) Spaces should be organized to provide special protection zones. When possible, spaces should be arranged to aid in providing fallout and/or storm protection. The nuclear fallout protection factor of a building is highly dependent on the materials of construction and the shape of the building. When fallout protection is required, an analysis should be performed to determine how to achieve the required area and protection factor. The results of the analysis may affect the building layout. When protection is provided in an underground location of the school the requirements of NFPA 101, will apply.

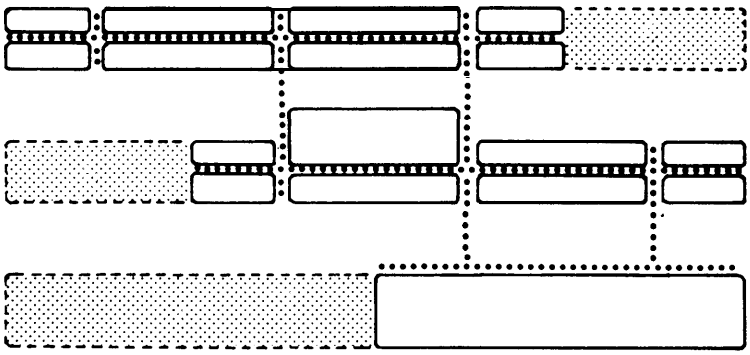


Figure 5-11
Expansion of Large Schools.

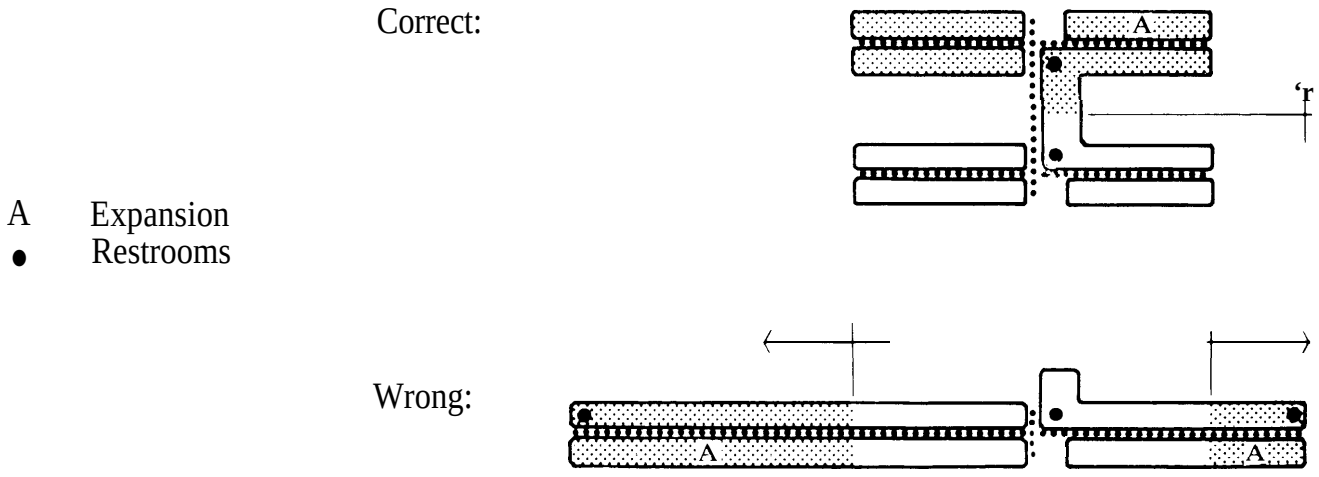
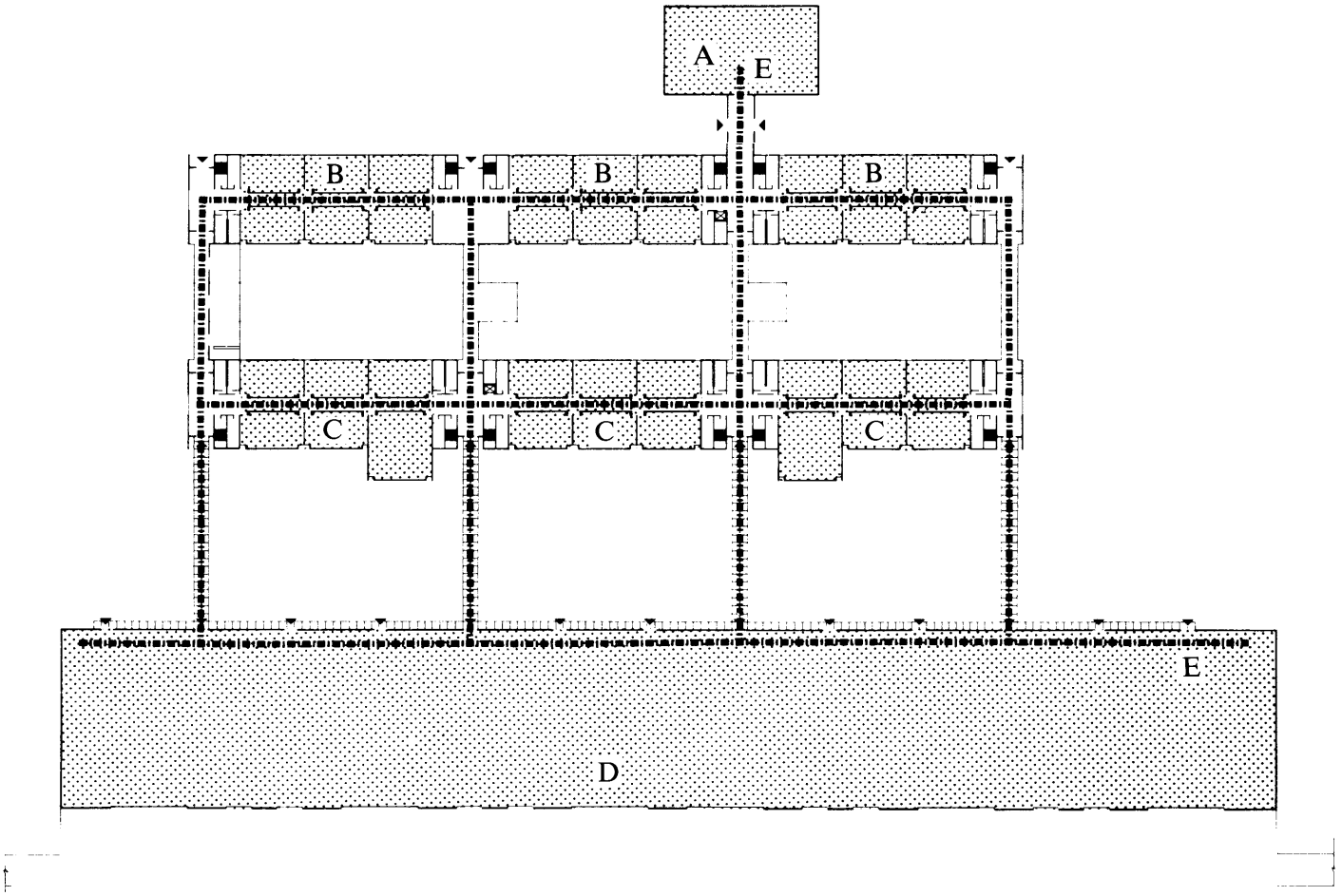


Figure 5-12
Expansion of Small Schools.

C. Flexibility and Expansibility

(1) Spaces must be organized to allow for change in use. Core spaces which contain functions unlikely to change (such as toilets and stairwells) should be clustered insofar as possible. Other spaces should be arranged so that floors can be economically designed to accommodate adequate live loads to allow the rearrangement or expansion of classroom areas. Non-load-bearing space dividers should be used where possible and ceiling heights should be adequate for normal classroom functions, with flexible services provided in the floor and/or ceiling systems.

(2) Spaces must be organized on the site to allow for a modular extension of the structure. Large multi-story schools should be designed for horizontal expansion along the perimeters so that adverse impact on school activities is minimal (Figure 5-11). An equivalent overhead vertical expansion of these facilities would produce major operational disruptions. Smaller, single-story schools (less than 60,000 sq. ft.) can generally maintain single-story construction and expand horizontally. Such expansion must be planned so as to maintain a compact, efficient shape that does not exceed maximum walking distances (Figure 5-12). Expansion planning for single-story schools larger than this should consider adding adjacent multi-story increments to satisfy expansion requirements. Schools larger than 60,000 sq. ft. will normally be more efficient and economical if multi-story construction is utilized.



A Technical Library
B Administration
C Classroom
D Applied Shop
E Primary Distribution Paths

Figure 5-13
Distribution of Primary Utilities.

5-4 Utilities Layout Principles

A. Distribution

(1) Spaces should be organized so that plumbing, mechanical and electrical equipment can be zoned. Space organization should consider comfort zones where different lighting conditions, temperature ranges and comfort controls may be required in conjunction with functional groups of spaces or sub-division of classroom units.

(2) Spaces should be organized to allow simple, direct provision of utility services. If spaces are organized into long bands with a common wall on a corridor, distribution of mechanical/electrical systems is simplified (Figure 5-13). Distribution panels and primary vertical mechanical service shafts may be located at corridor intersections as shown in Figure 2-13. This arrangement allows the following advantages.

- Direct branching into adjacent functional spaces.
- Acoustical separation from functional areas.
- Ready access for maintenance, alterations, and expansion.
- Installation without structural interference.
- Sufficient space for air distribution systems.

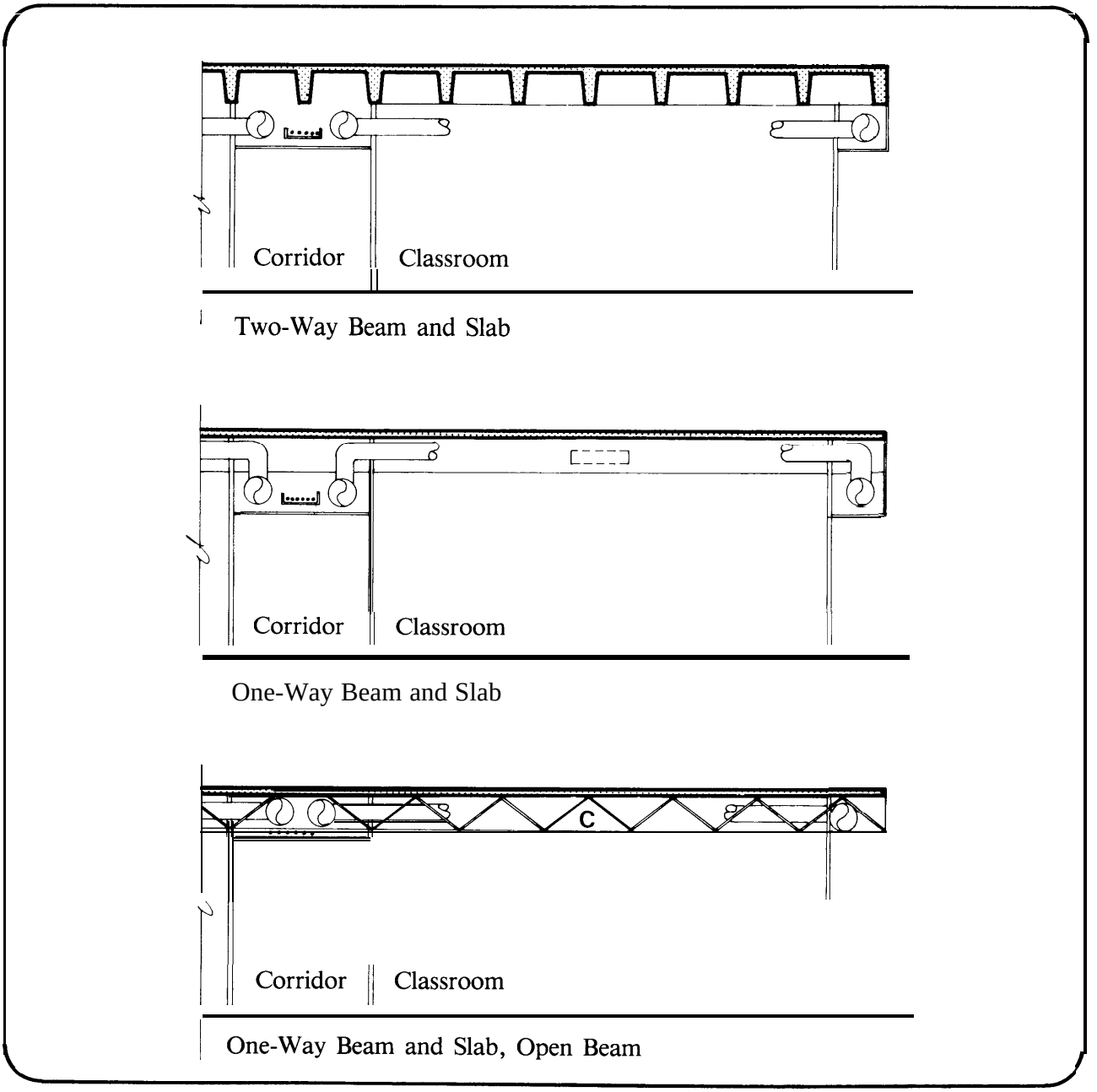


Figure 5-14
Integration of Utilities and Structure

B. Accessibility

(1) Schools should be planned so that maintenance of interior utility support does not disrupt functional activities. This principle is difficult to achieve; however, careful selection of equipment will minimize down-time, and location of equipment in mechanical rooms and in suspended ceilings in corridors will cause the least interference with school activities during maintenance (Figure 5-14). Planning of utilities should emphasize access-ways from nonfunctional space.

(2) Schools should be planned so that exterior utilities may parallel interior utilities without interfering with future expansion. Piped waste utilities should circulate outside, underground, and parallel to interior utilities lines. Access for high volume waste lines may be provided in crawl spaces under classroom floors.

5-5 Viewing Position Layout Principles

A. Visual Control.
Spaces should be located to allow visual control by administrative staff to maintain security and provide supervision of traffic and activity areas. When outside training is conducted visual control from executive offices is also desirable.

B. Visual Interest.
Spaces should be organized in conjunction with planned sequences of viewing positions. Service schools should be designed with a number of key focal points that provide students and visitors with necessary building orientation and functional organization information. These focal points should furnish visual clues to the activities taking place in the immediate area. Glass side lights at classroom doors provide a discreet means of accomplishing this and also decrease the hazard of blind openings. Lobbies and circulation nodes are primary focal points at which displays, bulletin boards, graphics, etc., can be placed for similar effect.

Focal points should be placed at key locations along the circulation routes through the building to provide a logical sequence of orientation and pattern. Long, unbroken corridors shall be avoided. Corridors should be interrupted at major intersections by staggering or providing vertical light shafts or patios. Travel from class to class should be a series of visual events provided by changing patterns, colors, and materials. (Figure 5-15).

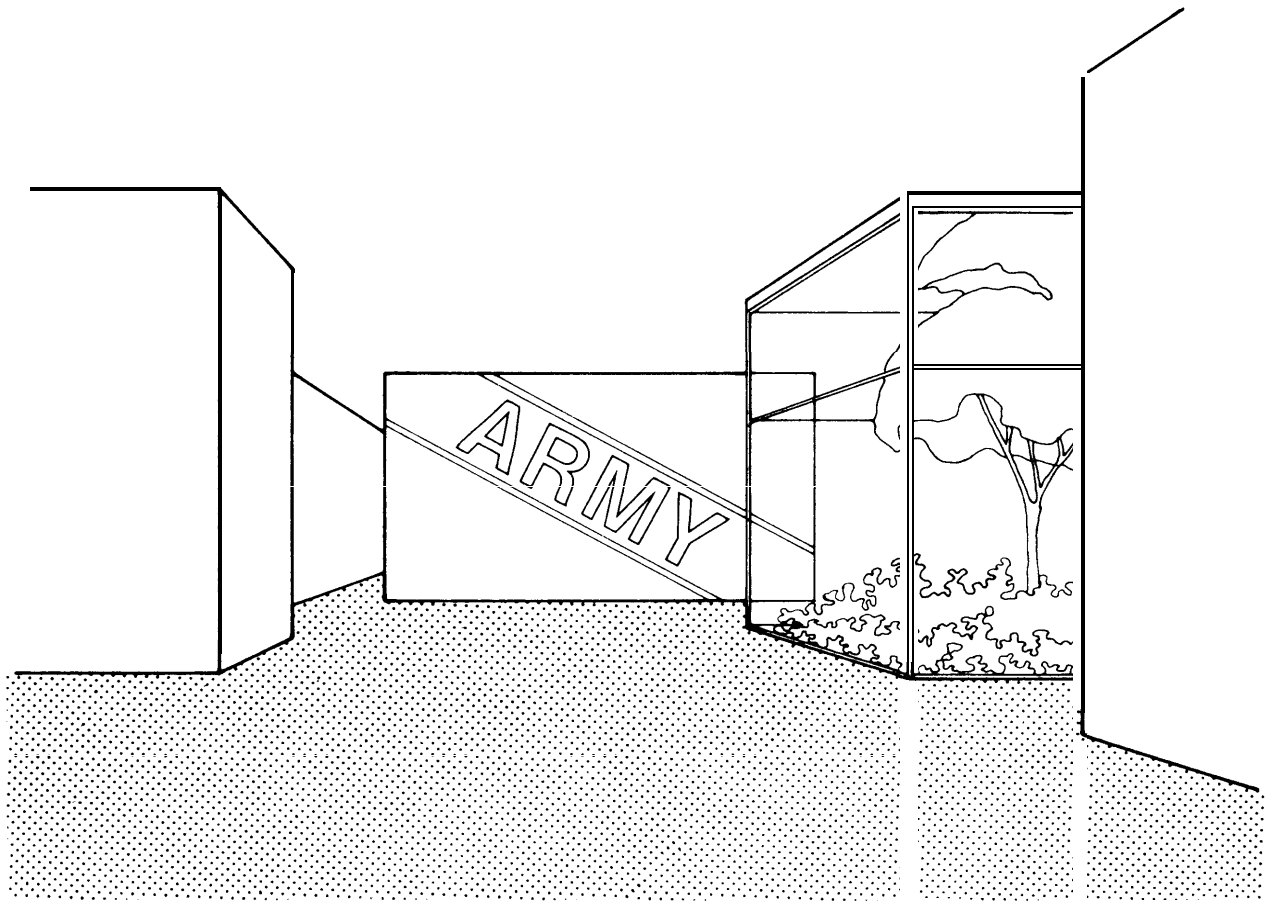


Figure 5-15
Visual Interest in Corridors