UNIFIED FACILITIES CRITERIA (UFC)

U.S. ARMY SERVICE SCHOOLS

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U.S. ARMY SERVICE SCHOOLS

U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes DG 1110-3-106, dated March 1991. The format of this UFC does not conform to UFC 1-300-01; however, the format will be adjusted to conform at the next revision. The body of this UFC is a document of a different number.

FOREWORD

\1\
The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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Foreword

The Design Guide (DG) series has been established to replace selected material previously issued under the standard design medium by the Engineering Division, Directorate of Military Programs, Headquarters, United States Army Corps of Engineers.

This guide governs design of U.S. Army Service Schools. The Army training program is contained in AR 350-1. Service schools support the general academic, technical and vocational education of military personnel of all grades and ranks.

This guide states basic planning and design considerations, criteria, and space organization principles, and illustrates how the guidance can be applied to respond to different requirements. This guide is applicable to all new construction projects for Army Service Schools and projects involving modernization of existing facilities.

Preparation of this guide was under the direction of the Building and Site Planning Section, Architecture and Planning Branch, of the Engineering Division, and is based on an architectural services contract with the firm of Naramore Bain Brady & Johanson, Seattle, Washington, under Contract No. DACA 73-74-C-0012. Material related to functional needs has been developed in conjunction with, and approved by, the U.S. Army Training and Doctrine Command (TRADOC), Ft. Monroe, Va. Portions of the material contained herein are based on improved habitability guidance provided by the U.S. Army Construction Engineering Research Laboratory USA - (CERL), Champaign, Illinois.

Distribution of this guide is limited. Additional essential copies are available from the USACE Publications Depot, 2803 52nd Avenue, Hyattsville, Maryland 20781.

Users are invited to send comments and suggested improvements to HQUSACE (CEMP-EA) Wash DC 20314.

FOR THE COMMANDER:

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1-1 Purpose

A. Design.
This guide provides criteria to govern the design of U.S. Army Service Schools, and to aid in the evaluation of such designs. This guide is directed towards improving early design decisions and towards the development of realistic, cost-effective spaces in conjunction with the Army regulations and DoD criteria referenced herein.

B. Planning.
This guide is also intended to provide general guidance for using service personnel and Corps of Engineers field offices in planning facilities for inclusion in military construction programs.

C. Improvement.
It is expected that using service personnel will find additional use for this guide in developing improvements or in better utilizing existing facilities.

1-2 Scope

A. Guide Limitation.
The criteria here in apply to all construction projects for Army Service Schools, whether for new construction or for altering existing space. While this guide is the basic criteria document, it is not intended to provide all of the information required for successful preparation of project designs. Supplementary information must be obtained from the installation to describe the exact requirements of the training program, and the locational constraints and opportunities of the site.

B. Presentation of Criteria.
Following the introduction, the guide contains four additional chapters which pertain to planning and design criteria; one on general design considerations, the second on special design factors, the third on individual space criteria and the fourth on space organization principles. The last chapter of the guide contains illustrative applications of criteria in the form of example designs. These designs are not intended to be definitive designs but to represent possible solutions for different requirements and local situations in order to demonstrate the intent of the guide.

C. Example Designs.
The example designs developed in the last chapter are for four typical training programs generating space requirements for 30,000 sq. ft., 150,000 sq. ft. and 400,000 sq. ft.

1-3 References

A. Functional Needs.
The following Army Regulations and directives are important in understanding the functions of Army training programs.

AR 350-1	Army Training
AR 351-1	Military Education and Training
DA PAM 570-558	Staffing Guide for U.S. Army Service Schools

B. DA Design Criteria.
The following manual is important in understanding the basic criteria governing the planning and design of Department of Army facilities.

Architectural and Engineering Instructions (AEI) — Design Criteria

C. Project Planning.
The following regulations are important in understanding procedures for planning facilities in conjunction with the development of Military Construction, Army (MCA), programs.

AR 415-15	MCA Program Development
AR 415-17	Empirical Cost Estimates for Military Construction

D. Design Execution.
The following Army and Engineer Regulations are important in understanding execution procedures which must be considered in the design of facilities designated for inclusion in MCA programs.

AR 415-20	Project Development and Design Approval
ER 1110-345-100	Design Policy for Military Construction
ER 1110-345-700	Design Analysis
ER 1110-345-710	Drawings
ER 1110-345-720	Specifications

E. Completion Records.
The following regulation is important in understanding the kind of records transferred to the using service upon completion of a project.

AR 415-10	General Provisions for Military Construction

F. Facility Design.
The following Army guides and manuals are important in understanding design requirements of Army service schools .

DG 1110-3-104	Design Guide for Administrative Office Facilities
DG 1110-3-110	Design Guide for Libraries
DG 1110-3-122	Design Guide for Interiors
TM 5-803-5	Installation Design
TM 5-807-10	Signage

TM 5-809-1	Load Assumptions for Buildings
FM 19-30	Physical Security
DA PAM 570-558	Administrative Offices

G. Upgrading Existing Facilities.
The following Army regulations and manuals are important in understanding the procedures involved in upgrading existing facilities.

TM 5-801-1	Historic Preservation-Administration Procedures
TM 5-822-2	General Provision and Geometric Design for Roads, Streets, Walks, and Open Storage Areas
AR 415-35	Minor Construction, Emergency Construction, and Replacement of Facilities Damaged or Destroyed
TRADOC Pamphlet 415-1	Winning Approval for Construction and Renovation of U.S. Army Service Schools

1-4 Emphasis

A. Design Quality.
Emphasis shall be placed on the quality of design since it will vitally affect the longevity, usefulness, efficiency, and attractiveness of the Service School. In addition to life cycle economy and functional efficiency, the overall design should exemplify regional character and an aesthetic rendering of both interior and exterior features.

B. Design Service.
Architects for these facilities should be selected on the basis of a continuing experience in design of educational facilities with similar functional requirements and a demonstrated imaginative approach to building design. They should also be considered for their ability to provide or accomplish professional interior design services.

C. User Information.
Provisions related to the efficient operation and maintenance of the facility shall also be emphasized during design. Information to supplement project completion records should be prepared to instruct the using service on how to gain the most benefit from such provisions.

1-5 Responsibilities

A. Using Service.
The using service for military construction projects is defined in AR 415-10, and its responsibilities are outlined in AR 415-20. The using service is responsible for:

(1) Development of functional requirements in conjunction with the guidelines in this guide.

(2) Justification of functional requirements falling beyond the scope of the guidelines in this guide.

(3) Preparation and submission of the Project Development Brochure (PDB) required by AR 415-20 and outlined in TM 5-800-3.

(4) Obtaining installation action to gain site approval if the project is not sited in accordance with the HQDA approved master plan.

(5) Preparation and submission of DD Form 1391, Military Construction Project Data, and supporting data in accordance with AR 415-15.

(6) Approval of concept designs to certify compliance with functional requirements.

B. Design Agency.
The Corps of Engineers field office responsible for design will:

(1) Insure that the function requirements of the using service are incorporated into the project design.

(2) Insure that the requirements of the using service fall within the scope of the guidelines in this guide.

(3) Insure that all deviations from this guide requested by the using service are adequately explained in project design analysis.

(4) Insure that the quality standards for overall design are emphasized as stated herein.

(5) Insure that the assemblage of user information is complete at the completion of the project, and provided, together with the completion records required by AR 415-10, to the using service.

1-6 Definitions.

A. General.

(1) Requirements.
Quantitative or qualitative factors generated by functional needs.

(2) Criteria:
Quantitative unit measures applied to effectively satisfy requirements.

(3) Design Elements:
Descriptive elements generated by the application of criteria.

(4) Principles:
Rules exemplified in the organization of a building design.

B. Functional.

(1) Applied Training.
Training in which students operate and/or maintain selected items of Army equipment.

(2) Chase:
A continuous vertical channel built into a wall for the purpose of carrying conduit or utilities.

(3) Circulation:
The orderly movement of personnel or vehicles along prescribed routes.

(4) Flexibility:
The capability of responding to new or changing situations; for the purposes of this manual, a facility, building, or room which can be adapted to new situations by expansion or reorganization of internal elements possesses the quality of flexibility.

(5) Functional Affinity:
A causal connection or relationship in function between two activities; for example, classroom instruction in principles and procedures and the applied training in which those principles and procedures are put into practice have a close functional affinity.

(6) Zoning:
The location of activity spaces, utility controls, etc. according to selected characteristics and relationships; for example, zoning activity spaces according to their function, or zoning lighting controls so as to control the lighting in spaces of a particular size.

2-1 General

This chapter discusses basic considerations related to the planning of Service Schools for inclusion in MCA programs, and consideration related to the design and review of such facilities. The material which follows is intended to establish general requirements and criteria within which to discuss special considerations, individual space criteria and space organization principles in the following chapters.

2-2 Army Training Program

A. Functional Requirements.
Army Training Programs are established to assist personnel in developing their job skills, intellectual leadership abilities, and their overall career potential. The composition and the size of the training program needed in each particular case is the basis for delineating the functional requirements for a Service School Facility.

B. Mission.
The mission of a typical U.S. Army Service School includes:

(1) Training:
Resident instruction and training in specific aspects of U.S. Army doctrine, policy, and procedures and in the maintenance, operation, and employment of selected items of Army equipment.

(2) Training Literature:
Developing, producing, and reviewing both school-related and Army-wide training literature.

(3) Doctrine:
Developing doctrine for the branch of the Army served by the school and participating in force development activities which affect that branch.

C. Instructional Program.
AR 351-1 identifies the various kinds of instructional programs offered by Army Service Schools. Some of the important courses offered are described below. Specific information concerning the schools and courses offered may be found in DA PAM 351-4, U.S. Army Formal Schools Catalog.

(1) Professional Development Course:
This course is designed to prepare commissioned officers, warrant officers, and non-commissioned officers to effectively perform the duties required in assignments of progressively greater responsibility. It usually includes instruction in military operations, resource management, and leadership. Such courses generally require from 3 to 9 months to complete.

(2) SW Progression Course:
This course is designed to train military personnel, usually lower grade enlisted personnel, in skills related to a specific military occupational specialty (MOS). Such courses normally require from 3 weeks to 3 months to complete.

(3) Functional Course:
This course is designed to enhance the effectiveness of military personnel in selected functional areas, for example, in the maintenance or operation of particular items of Army equipment. Such courses generally require from 1 to 4 weeks to complete.

D. Student Participants.
The following categories of personnel are eligible to attend Army schools and Defense schools operated by the Army:

(1) Active Army personnel.

(2) Active duty personnel of the other services.

(3) Personnel of the Reserve Components of all services.

(4) Military students from foreign countries participating in the Security Assistance Program, or from other friendly foreign countries when such training is determined to be in the best interests of the United States.

(5) Civilian personnel employed by the services and by other U.S. local, State and Federal governmental agencies, on a space-available basis.

(6) Civilian personnel of industrial or research organizations under contract to the U.S. Government when such training is not otherwise available and is deemed essential for fulfillment of the contract.

E. Staff Assignment.

(1) Organization.
The general staff organization of U.S. Army Service Schools is depicted in Figure 2-1. This chart is a guide only; the internal organization of staff elements varies between schools as necessary to meet their respective missions, areas of emphasis, workload and operating conditions.

(2) Authorization Levels.
Detailed information and computation procedures concerning numbers and types of positions authorized for programed student loads are provided in DA PAM 570-558, Staffing Guide for U.S. Army Service Schools. Information pertaining to a specific school is

available from the most recent Manpower Survey Report, and Training Base Review (TBR) statistics.

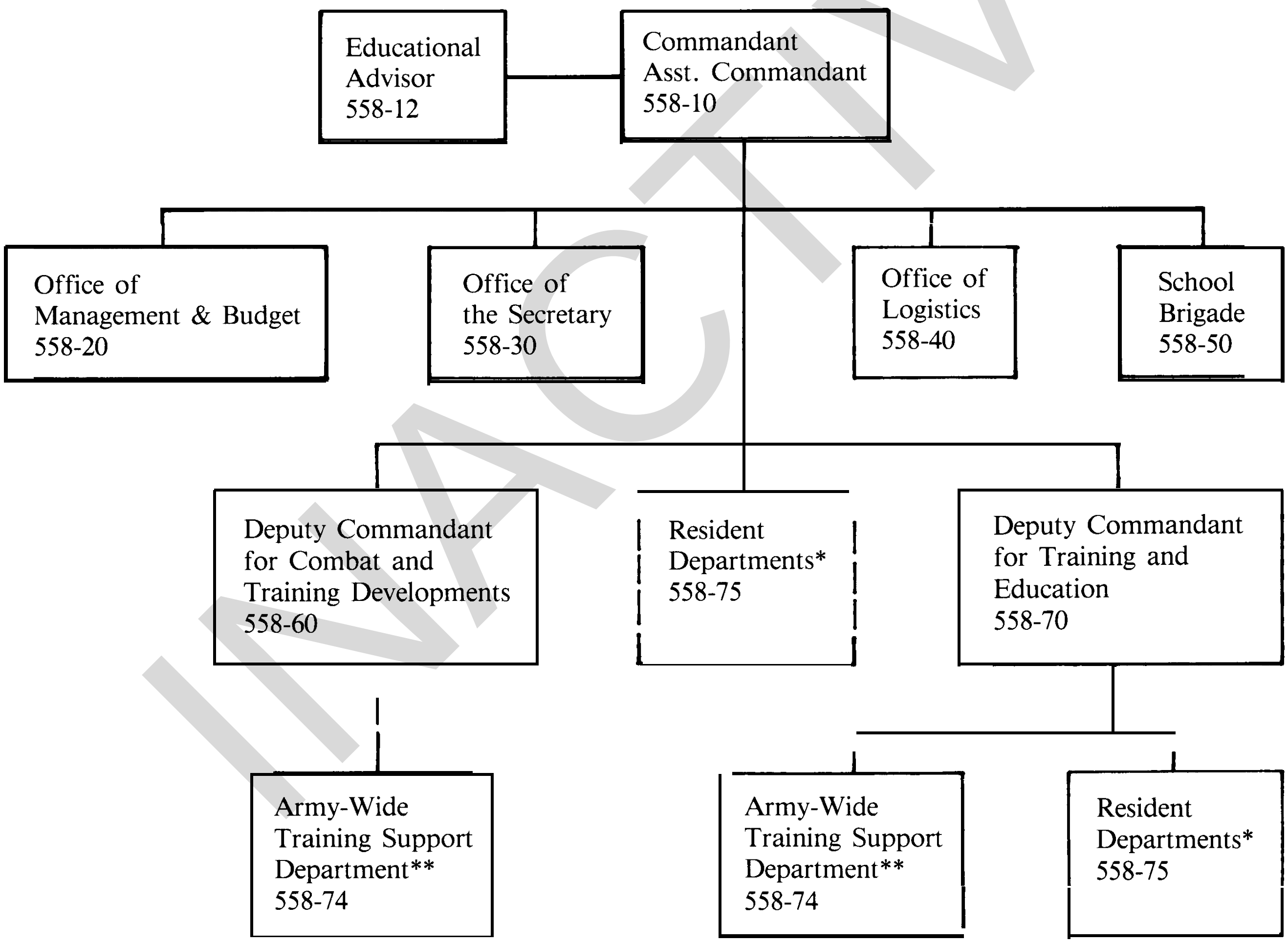
F. Instructional Support.

While the common teaching method of lecture and testing is applied widely in many courses, the use of visible, audible, and manipulative ("hands-on") training aids has been a tradition in Army training. Consequently, use of training devices in Army schools has reached a high level in scope and sophistication. Training devices include actual army equipment, full scale mock-ups, simulation models, programed display panels, motion pictures, cable and cassette TV systems, recordings, programed self-instruction casette and computer terminals, graphics, felt boards, multi-frequency lighting, etc. Depending on the size, nature, and complexity of these devices, classrooms might become more or less "dedicated" in order to accommodate their usage. It is expected that the trend toward sophisticated training devices will result in a continuing requirement for large amounts of dedicated special purpose classroom space; however, the necessity for dedicated classrooms can be minimized by providing as high a degree of flexibility in general classroom design and equipment as possible.

G. Unique Characteristics.

(1) Frequent Changes in Instructional Program and Student Load.

Since much service school instruction involves training in the use and maintenance of Army equipment, changes in this equipment or in the procedures governing its use require corresponding changes in instructional programs. Changes in student load due to changing Army manpower requirements are also common. The number of students in training may vary widely between successive classes, and this situation often occurs with little advance notice.



*Resident Departments may optionally be organized under the Office of the Commandant

**Army-Wide Training Support Department may optionally be placed under the Deputy Commandant for Combat and Training Developments

Figure 2-1
U.S. Army Service School Organization Chart

(2) Required Readiness for Mobilization.
Emergency mobilization will produce a sudden and substantial increase in the student and instructor population, resulting in a population level that may be three times as high as that of normal conditions and require multiple-shift school operations.

(3) Emphasis on "Hands-On" Training.
A large percentage of service school instruction consists of hands-on training; that is, practice in operating and maintaining actual or simulated Army equipment. This type of instruction often requires a large number of specialized training laboratories and shops with convenient access for large pieces of equipment.

(4) Low Instructor-Student Ratio.
Service school instructional methods are generally based upon low instructor-student ratios, sometimes as low as 1:2. Therefore a larger amount of space must be programed for instructor support than is the case in most civilian educational facilities. This does not mean, however, that each instructor requires an individual space; a large percentage of Army instructors is involved in group activities, such as maintaining school equipment and property, when they are not teaching. Such personnel do not require individual offices or activity spaces.

(5) Accommodations for the Handicapped.
Provision must be made for those visitors, members of the staff, and civilian students who may be handicapped. Design shall be in accordance with AEI - Design Criteria, Chapter 7.

H. General Planning Factors.
Each U.S. Army Service School has a unique instructional mission. The success of school design is measured by the efficiency and effectiveness with which each school can accomplish its mission in the spaces provided. A successful school design, therefore, must respond to the particular requirements of the individual service school. The following general information about service schools should be considered in preliminary school planning.

(1) More than 75% of all service schools fall into three categories based on the ratio of shop to classroom instructional space:

a. Schools having predominately shop instructional space (4:1 ratio, shop to classroom space).

b. Schools having approximately equal amounts of shop and classroom space.

c. Schools having predominately classroom instructional space (4:1 ratio, classroom to shop space).

(2) These three categories represent a grouping of service schools according to average square footage per person:

Category	Average Square Footage per Person
a	300
b	215
c	175

(These figures are based on gross area tabulations and school population figures for FY 72 as furnished by HQ, TRADOC. The population figures include both students and authorized military and civilian school personnel.) Although these figures are averages and thus cannot be used as firm planning criteria, they nevertheless suggest that a relationship exists between a school's shop-classroom ratio and the gross area per person that the facility must provide. They also furnish a rough quantitative measure of the space required by the different kinds of service schools. These data, when combined with specific local information, may be useful for preliminary planning studies.

2-3 Planning the Service School

A. Requisites.
The sequential activities whereby a project is authorized and constructed are delineated in AR 415-15, AR 415-17 and AR 415-20. Since most U.S. Army service schools represent a large investment in physical plant by the Army, a thorough study should be initially performed by the using service including feasibility, program evaluation, economic analysis and construction requirements. Such studies should consider full or partial utilization of existing available space, new facilities, alternate site locations, rental space, contracted training, joint use of training facilities under other commands and services, etc. AR 37-13, Economic Analysis and Program Evaluation, contains instructions for performing an economic analysis and program evaluation. As a minimum, such studies must establish the site of the school, the program of construction (both renovation and new), and the approximate cost. Such initial studies shall not include design beyond the level of establishing building area and site support requirements. Due to the complexity of the problem of relating a changing curriculum and student load forecast to the changing technologies in teaching aids and construction, the services of a consultant may be desirable. Once the requirements are established, the using service must prepare a DD Form 1391, Project Development Brochure and other documentation to obtain HQDA, DoD and Congressional approval and funding.

B. Planning the Site.

(1) HQDA Approved Siting.
The site of the facility shall be as shown on the HQDA approved Installation Master Plan of the installation. If the facility is not shown thereon, approval must be obtained in accordance with AR 210-20, Master Planning for Permanent Army Installations, before the project will be reconsidered for design and construction. The location selected should be responsive to the economic analysis discussed in 2-3a above and 2-4 below, and should meet the following functional requirements, as applicable:

a. Sufficient real estate to permit accommodation of buildings, outdoor training areas, parking, student housing and mess facilities, and other support required at the site.

b. Near to existing available quarters and installation support facilities such as post exchanges, libraries, training aids facilities, etc.

c. Relatively quiet and uncontested area conducive to study.

(2) Site Sketch.
Although a detail site plan is not normally required for submission with the 1391, preparation of a site sketch will assist in preliminary budgeting. A tentative orientation should be established taking into consideration the following factors:

a. Convenience of access for pedestrians, drivers and service vehicles.

b. Direction of sun and prevailing wind.

c. Land forms, grading and drainage.

d. Views.

e. Location of utility connections of adequate size.

f. Future expansion.

g. Access to field training areas.

(3) Estimating Site Costs.
Empirical Cost Estimates are prepared in accordance with AR 415-17, which provides unit cost figures for all types of building and support facilities normally required for service schools; therefore, establishing the costs of site requirements is initially the most important consideration. Specific site utility requirements must be estimated by mechanical and electrical design engineers. Separate items should be listed under Supporting Facilities (Blank 21) on DD Form 1391 (Figure 2-2) to include, as appropriate:

a. Site preparation

b. Grading*

c. Paving (drives, parking and walks)*

d. Demolition

e. Water

f. Sanitary sewer

g. Gas

h. Fencing

i. Landscape planting

j. Exterior electrical*

k. Communications

1. Signage*

*Including features for the physically handicapped.

C. Planning the Buildings.

(1) Space Requirements.
With the exception of General Academic Classrooms, AEI - Design Criteria does not set forth space allowance criteria for service school facilities. The space program requirements should be prepared by using the service in conjunction with initial feasibility studies. This information should be updated if the forecasted curriculum and/or student load change during the process of authorization. Actual space requirements should be estimated using the information in this guide and the appropriate figure entered in Blocks 18.f, 20.a, 23a, and 23.h of DD Form 1391. The size of mechanical space required to heat and air-condition the school should be estimated by a mechanical engineer and entered separately on Block 20.b. as “Heating and Air-Conditioning Plant” or ‘‘Mech Room”, as appropriate. The figure obtained from the addition of all building area requirements should be entered on the top line of Block 20 of DD Form 1391. Block 17.a. should be checked and ‘‘DG 1110-3-106” should be written in block 17.c. See AR 415-15 for complete instructions on completing DD Form 1391.

1. COMPONENT ARMY	FY 19____ MILITARY CONSTRUCTION PROJECT DATA	2. DATE

3. INSTALLATION AND LOCATION	4. PROJECT TITLE

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DD FORM 1 DEC 76 1391 PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED. PAGE NO.

FOR OFFICIAL USE ONLY

(WHEN DATA IS ENTERED)

Figure 2-2
DD Form 1391

(2) Estimating Building Costs.
The unit cost figures shown in AR 415-17 include equipment and furniture which is permanently built into or attached to the structure. These include the following items which should be estimated as part of the bulding cost.

a. Built-in counters, sinks and shelving.

b. Efficiency kitchen unit and drinking water coolers.

c. Central PA and speaker system.

d. Telephone, fire alarm and intercom systems.

e. Built-in laboratory furniture, hoods and vents.

f. Built-in typing and tape playing decks.

g. Built-in movable partitions.

h. Built-in projection screens.

i. Elevators and conveyors.

j. Waste disposers.

k. Floor and window coverings.

j. Chalk boards, bulletin boards and display cases.

m. Signage and graphics.

n. Special features for the handicapped.

o. Other specialty items as identified.

D. Planning for Interior Furnishings.

(1) Preliminary Schedules.
Interior furnishings must be planned in coordination with the buildings in order to develop a totally integrated and useful facility. Items which are portable or detached from the structure must be identified for procurement by the installation using service utilizing other than MCA funds. Sources for selection of furnishings and equipment are provided in the GSA Federal Supply Schedules, the Federal Prison Industries Schedule of Products and the general GSA Supply Catalog.

(2) Estimating for Interior Furnishings.
Much of the Service School equipment and furnishings are portable and therefore, not included in the building cost estimate. These items must be estimated separately and programed for procurement utilizing Operations and Maintenance, Army (O&MA) or other funds. Estimates for furnishings should be based on the mandatory source prices, plus escalation. Paragraph 6 of the required supporting data for DD Form 1391 must include a summary and cost of the furniture and equipment that is being programed from funds other than MCA. The following list indicates some of the items that should be included in paragraph 6, supporting data for DD Form 1391.

a. Audio-visual equipment, TV systems.

b. Training equipment including simulators.

c. Chairs, tables, study carrels.

d. Lounge furniture.

e. Service carts and equipment.

f. Storage and filing cabinets.

g. Microfilm equipment.

h. Reproduction machines.

i. Wall clocks, plug in.

j. Other items identified as detached.

(3) Scheduling Procurement.
Estimates of items being programed from funds other than MCA must be finalized using the most current mandatory source prices. Procurement should be scheduled so that the furnishings are available shortly **before** the projected date of beneficial occupancy.

2-4 Designing the Service School

A. Requisites.
Activities associated with the development and execution of design are outlined in AR 415-20 and ER 1110-345-100. The AEI - Design Criteria, is the basic criteria reference. Technical Manuals (TM) and other documents state additional criteria. Design must be based on the requirements and estimates established in the final approved DD Form 1391. Present procedures require preparation of design analysis, drawings and specifications. Preparation of these documents is covered in ER 1110-345-700, 710, 720, respectively. In preparing these documents, the following guidelines should be applied.

B. Designing the Site.

(1) References.
Site design must be accomplished in accordance with applicable portions of the AEI - Design Criteria, TM 5-822-2 and 3, TM 5-830-1 and the completed Project

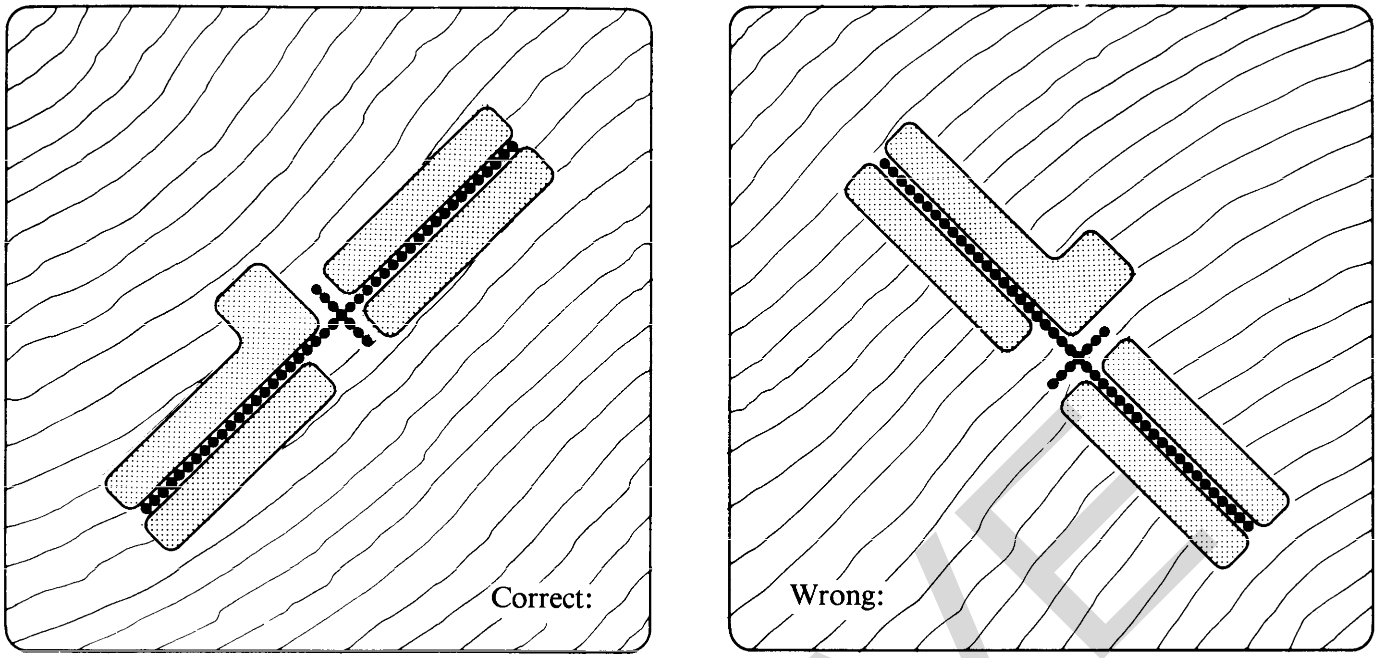


Figure 2-3
School Siting, Sloped Terrain

Development Brochure for the individual project. The objective of site planning is to develop the relationships between the school and such elements as the terrain, climate, and post so as to maximize the efficiency and economy of school operations while rninimizing disruption of post activities and the natural environment.

(2) Building-Site Relationships.

(3) Environmental Planning.
Site design must take into account the terrain, surface and subsurface characteristics of the soil, local vegetation, and climatic conditions, and must include a thorough assessment of the impact of the facility on the environment in accordance with the requirements for environmental impact statements.

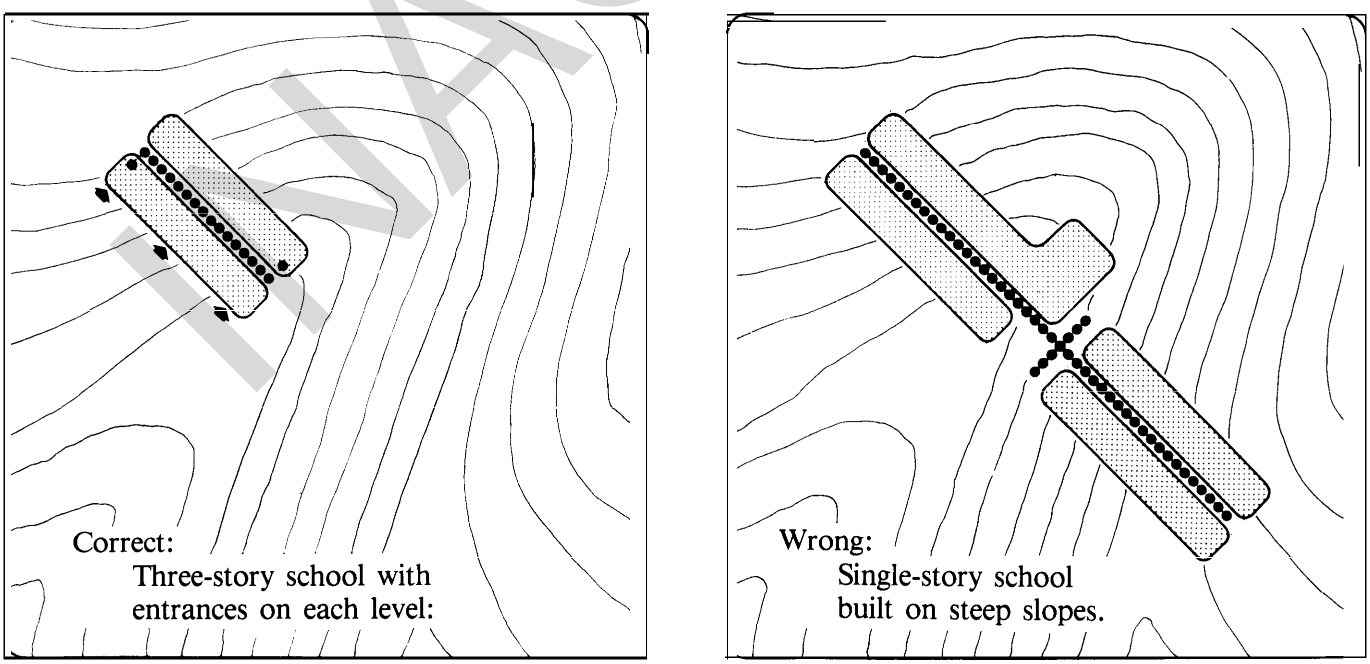


Figure 2-4
Building Type/Slope Relationship

b. Terrain Configuration.

The site planning process requires analysis of the scale and character of the geographic and topographic features of the site. Large scale features, such as site slope characteristics, require specific architectural and planning responses, while smaller scale features should be considered from the standpoint of their potential value in enriching the school environment. Wherever possible the design shall minimize environmental impact while maximizing ease of construction. For example, the facility should be designed so as to cross as few elevation contours as practical (Figure 2-3). If other considerations, such as solar orientation, dictate that the facility must cross major variations in slope contour, the building should utilize a vertical, rather than horizontal, spatial organization (Figure 2-4). Such designs minimize the amount of earth-moving necessary for site preparation, thereby reducing environmental disruption and enhancing ease of construction.

c. Surfaces and Subsurface Soil Characteristics.

The organic composition and drainage characteristics of the soil determine the landscaping potential of the site and must be considered during the site selection process. The drainage characteristics and compressive bearing strength of the soil are critical in foundation design and must be determined in accordance with TM 5-818-1, **Procedures for Foundation Design of Buildings and Other Structures.** The determination of soil drainage characteristics will also include assessing the effects of the facility and its adjacent paved areas on the ground water level.

d. Climatic Conditions.

Skillful utilization of natural environmental controls can significantly increase building economic efficiency. Factors to be considered include prevailing winds, topography, and vegetation. Facilities located in areas subject to extreme climatic conditions shall be designed so as to minimize heating and cooling requirements. In general, this is accomplished by designing multi-level, compact buildings which minimize heat transfer gains and losses (Figure 2-5). The siting and orientation of facilities must take into account the velocity and direction of prevailing winds. These data will be used in planning for the dispersal of emissions (smoke, fumes, dust) and in designing building shapes and configurations so that winds and drifting snow do not disrupt vehicular and pedestrian circulation. The exploitation of natural controls may require a less compact building shape, or an orientation other than north-south. When programing for a particular project, the advantages of compactness and north-south orientation must be weighed against the increased efficiency to be derived from a full exploitation of natural controls.

e. Vegetation.

Landscape planting is one of the most effective methods of adapting a school to its site. As far as possible, indigenous vegetation will be preserved throughout the facility complex. This natural growth should be supplemented with planting that employs locally occurring plant species. This technique of preserving indigenous vegetation and planting with local species is one of the simplest means of developing the regional character of the site.

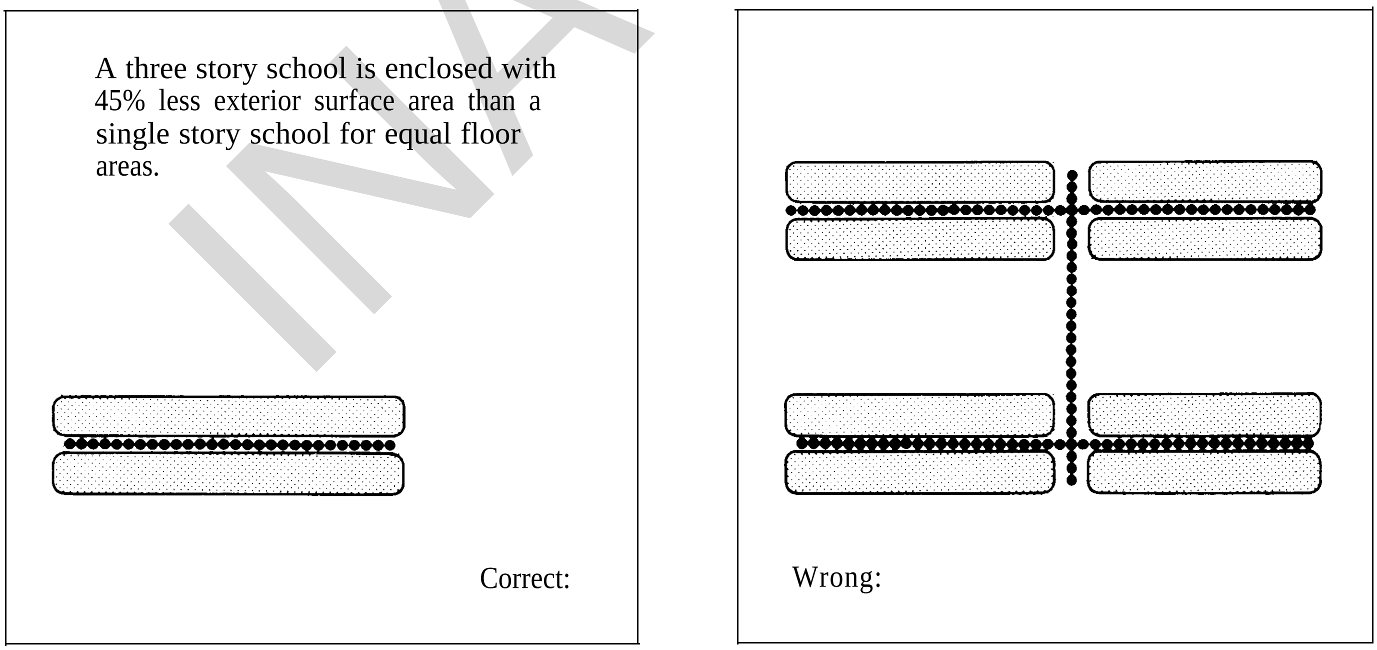
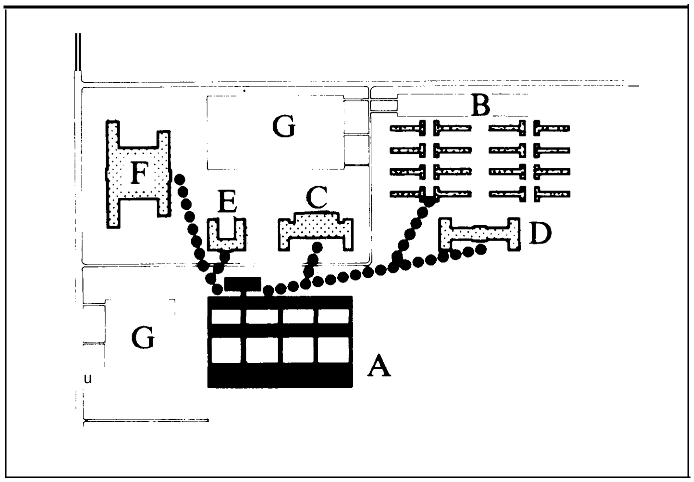


Figure 2-5
Building Type/Climate Impact



A Service School
B Bachelor Housing
C Post Exchange
D Dining Hall
E Training Aids Facility
F BOQ
G Parking

Figure 2-6
School-Post Relationships

f. Screening of Utility Features.
Utility areas, such as trash bins, transformers, utility connections, etc., should be screened to the maximum extent practicable by sue of plantings, land forms, and architectural screens to blend with the surroundings. Utilities located on roofs should be carefully studied during architectural detailing.

g. Views.
A landscape is usually perceived from a number of viewpoints: sidewalks or paths, terraces, entrances, windows and balconies. Lines of sight should be carefully analyzed. Pleasant aspects of existing views should be maximized, with care taken to avoid views into the sun. Windows should be located so as to provide both natural lighting and contact with the natural environment.

h. Relationship of School to Post.
The school-post relationship involves interactions of both function and circulation. The service school should be designed so as to establish a close relationship to supporting post activities. (Figure 2-6). The most important of these are:

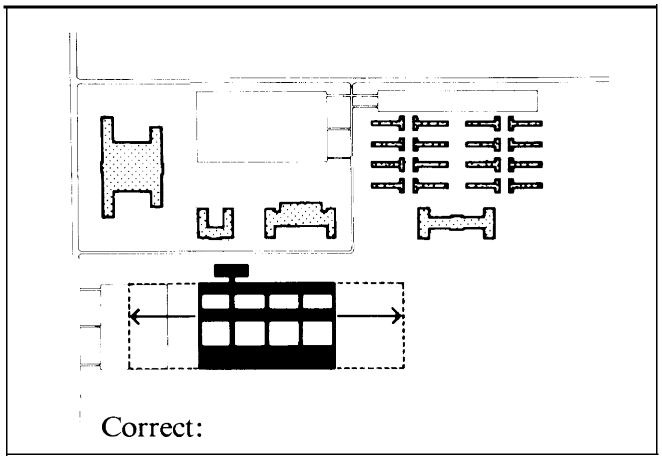
- Bachelor Housing. The school should be designed to promote pedestrian circulation between the school and associated bachelor housing.
- Dining. The prime consideration here, as with housing, is facilitating pedestrian circulation. Appropriate dining facilities for all types of personnel (military and civilian) shall be provided within walking distance of the school. If existing facilities are inadequate or unavailable, snack bar and cafeteria space shall be programed with the school.
- General Post Services. When feasible, the school site should be arranged so that school personnel can walk to such major post services as the PX, commissary, laundry and dry-cleaning facility, and recreation centers.

i. Future Expansion.
The school will be designed so as to allow for future expansion taking into consideration existing or planned post facilities which would limit orderly growth of the school. (Figure 2-7).

(3) Vehicular - Pedestrian Systems.

a. Organization.
The school site must be planned so as to minimize conflict between school and post circulation patterns. To achieve maximum pedestrian flow and safety, vehicular arterials should not run through the school grounds or between the school and such school-support activities as housing and dining facilities, formation areas, and field training areas. (Figure 2-8).

b. Service Areas.
Access for fire fighting equipment and trash removal equipment must be provided. Unloading facilities for deliveries must be orderly in appearance and not in conflict with pedestrian or vehicular traffic. Service areas and service roads must be sized to accommodate the turning radii and maneuvering requirements of the largest vehicles. At the same time, the extent of paving should be minimized. Screening of service areas should be accomplished in conjunction with the screening of utilities features.



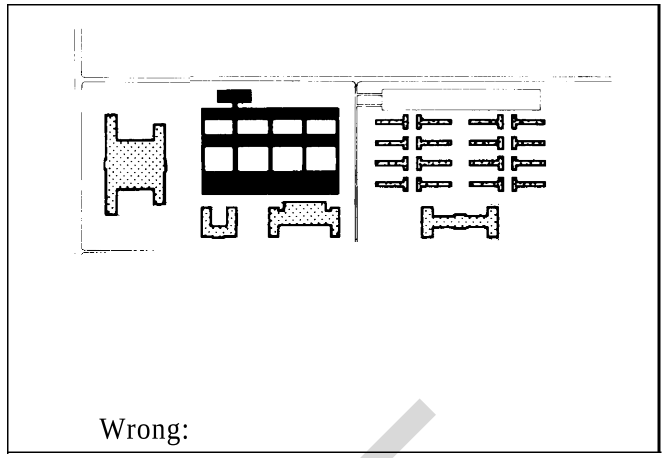


Figure 2-7
Siting for Expansion

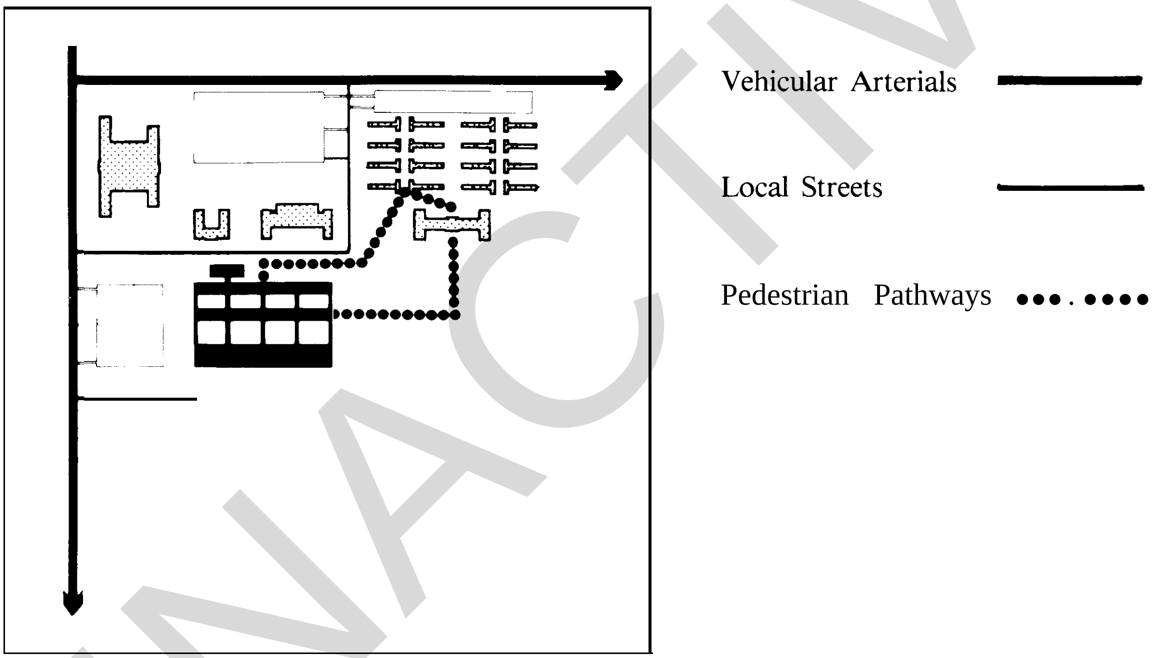


Figure 2-8
School and Post Circulation Systems

c. Shop Areas.

Access to shops must be provided for students and instructors, for training equipment, and for supply deliveries. Pedestrian access should be from one side of the shop, vehicular access from another. (Figure 2-9). Training equipment and delivery vehicles may share common circulation routes. Shop access is also affected by the size of the equipment to be housed. Shops planned for unusually large equipment, such as cargo helicopters, may require a single large entranceway at one end of the shop. (Figure 2-9). Shops designed to house a number of smaller items, such as trucks or tanks, may require entrances on two or more slides to facilitate movement of equipment. (Figure 2-10).

d. Walkways.

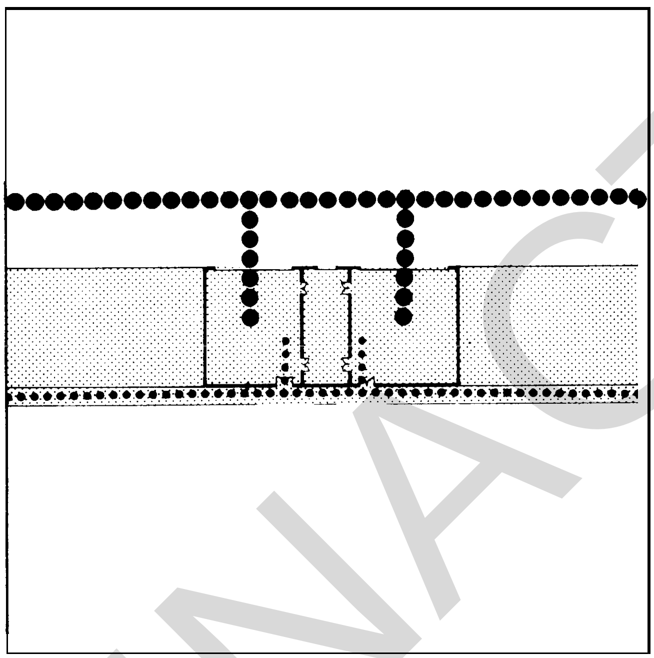
Selected major walkways must be designed to support vehicular traffic such as fire-fighting equipment, delivery vehicles, and vehicles moving heavy or bulky items. Such walkways should be a minimum of 12 feet wide. Walkways for the physically handicapped should be a minimum of 6 feet wide.

e. Formation Areas.

Site design will include identifying large, open spaces to be used as student formation areas. Ideally, these areas should be located on the side of the school closest to student housing and dining facilities.

f. Parking Areas.

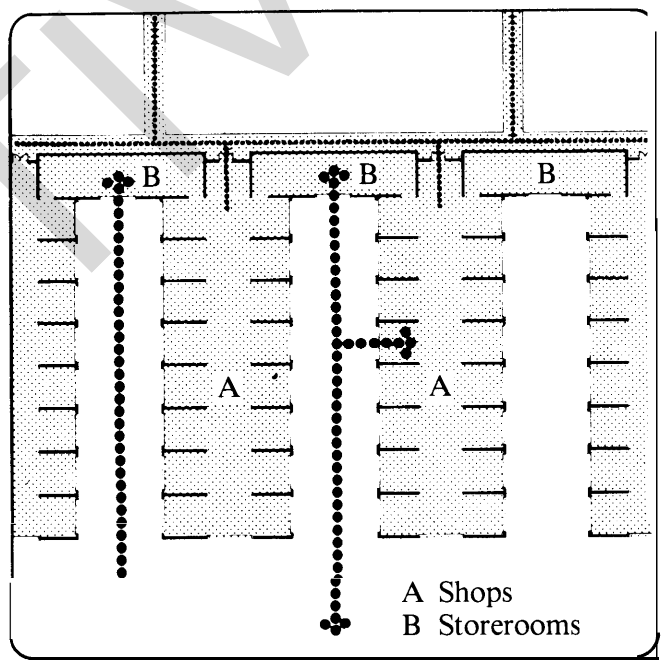
Parking areas must be provided for the school staff and visitor who drive to school daily. These areas should be placed along the edges of the facility so as not to interfere with pedestrian circulation within the



Pedestrian Circulation ....

Vehicular Circulation ●●●●●●●●●●●

Figure 2-9
Shop Area Circulation



Pedestrian Access ....

Equipment and Delivery Access ●●●●●●●●●

Figure 2-10
Multi-Bay Shop Area Circulation

A Correct Location for Parking

B Wrong Location for Parking

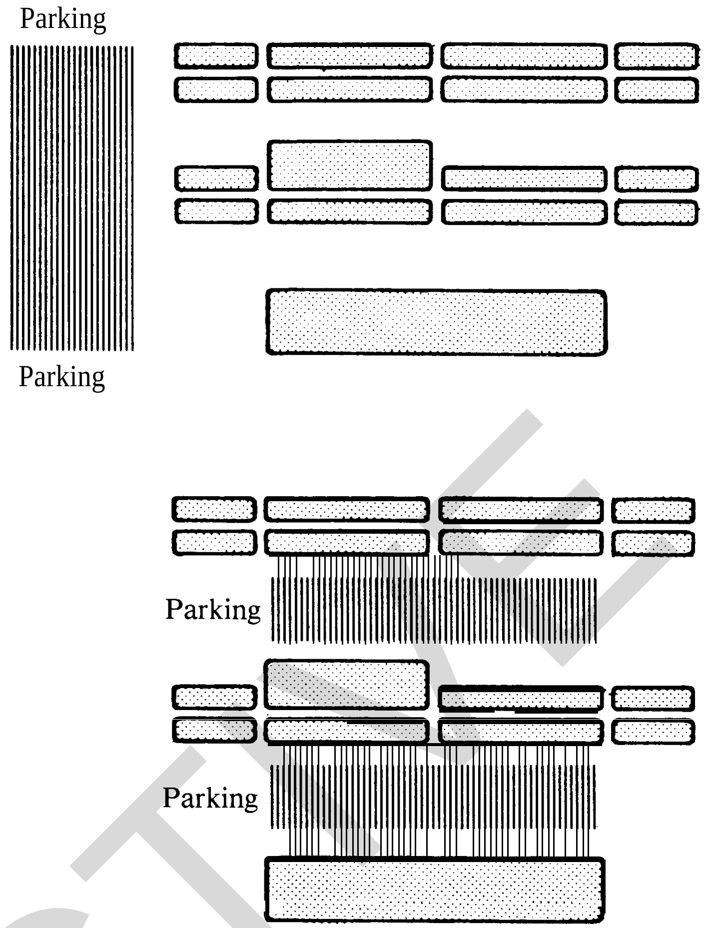


Figure 2-11
Siting Parking Areas

school. Parking facilities for the handicapped shall be in accordance with AEI - Design Criteria, Chapter 7. Parking areas shall be adequately landscaped to soften the impact of large paved areas. Planting shall be supplemented when topography permits by depression or earth mounding. (Figure 2-11).

g. Field Training Areas.
Most U.S. Army service schools conduct a portion of their training in the field. Circulation must be designed to allow direct access to field training areas; students and equipment enroute to field training areas should not disrupt school or post circulation patters. (Figure 2-12). Where field training areas must be located at a remote location, provision shall be made for covered marshaling terminals at the service school site to accomplish orderly transportation of classes to the field.

h. Lighting and Signage.
Lighting shall be provided along all streets, pedestrian ways, and parking areas to accommodate safe and efficient vehicular and pedestrian circulation. Lighting shall also be provided for night-use outdoor training areas and other outdoor peripheral facilities necessary to the mission of the school. Directional and identification signs must be furnished to locate all buildings, access drives, parking and entrances. Features for the physically handicapped, restricted areas, service access, and other special use areas will be identified. Signage and graphics must be in accordance with TM 5-807-10.

(4) Drawings.
Site plans should show, as a minimum, floor elevations, existing and finished grades, existing and proposed buildings, roads, parking and utilities in the immediate project vicinity, outside utility connections, existing vegetation, proposed lawns and planting masses, and solar orientation. Grading, paving, utility and landscape planting plans must also be prepared.

C. Designing the Buildings.

(1) References.
Building design must be accomplished in accordance with applicable portions of AEI - Design Criteria, the

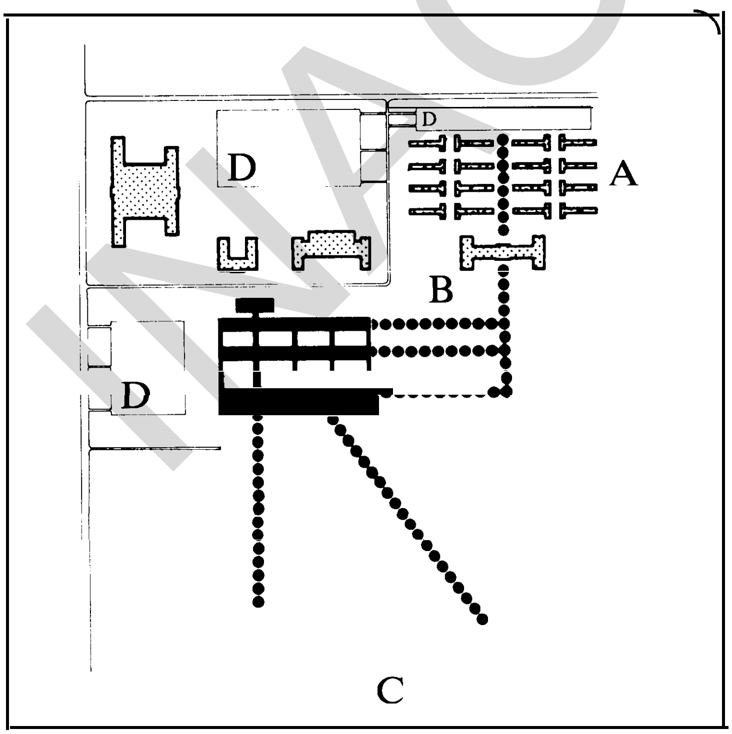
completed Project Development Brochure for the individual project, and applicable Army technical Manuals and Engineers publications identified separately under the following headings.

(2) Architectural.

a. Character.

The architectural character of a facility directly affects its users and their activities. A good design incorporates organizational and sensory characteristics than enhance the functional activities of the facility.

- Inviting Design Characteristics. A primary goal of the design process is to create a school that is inviting and convenient to both occupants and visitors. Especially important are the location, expression, and identification of entrances. Another aspect of this effort includes the selection of colors and textures that relate appropriately to the environmental context of the school and post. School buildings should exemplify the characteristics of local and innovative construction practices, with materials chosen on the basis of availability, simplicity and economy, and capability to generate visual interest.
- Adaptation of Environmental Context. A primary measurement of good architectural design is the success with which it is adapted to a particular environment. Specifically, such factors as site and climate provide the basis for determining appropriate architectural responses. For example, a desert environment requires a facility that provides protection from heat and glare, with entrances that accomplish a comfortable transition between the bright sun on the exterior and the relatively dark interior. In wet climates, rain protection along passages between buildings shall be considered, and in extremely hot or cold climates, compact single-structure schools that minimize outdoor circulation are appropriate. Environmental considerations such as these are an integral part of an attractive and functional design.
- Facility Identity and Organization. The typical service school conducts many short training programs and has a large and rapid turnover of students. If these students are to become familiar with the school in the short amount of time available to them, the school must be readily identifiable as a unit and have a visually apparent organization that facilitates orientation and circulation. It is important that the room and corridor identification system be clear, especially in larger facilities. Furthermore, all such systems must be capable of extension in the event school facilities are expanded.
- Sensitive to Architectural Context. All new construction should be sensitive to adjacent construction with historic significance. Such building design should follow guidelines in TM 5-801-1.



A Bachelor Housing
B Dining Hall
C Field Training Areas
D Parking

Figure 2-12
Planning Related Activities

- Lockers. Lockers should be near classroom and training spaces. Crowding can be avoided by making corridors wide enough to accommodate both the normal traffic load and the activity of students at lockers lining the corridor walls. Congestion can also be relieved by placing locker sections and groupings off main corridors.
- Intersections and Circulation Nodes. As illustrated in Figure 2-14, corridors should widen at points of queing and decision such as corridor intersections and entrances to stairways. Space must be provided at these points for pedestrians to pause or circulation flow will be impeded. At building entrances, the corridor must widen to provide space for entering personnel to orient themselves and exiting personnel to prepare for outdoor weather conditions; moreover, adequate lighting must be installed at entrances to aid those entering in adjusting to a lower level of illumination. (See paragraph 3-3b(3).
- Corridors should be safe. Their walls should be free of all projections. Heating units, drinking fountains, fire extinguishers, lockers, doors, and display cases should be recessed for safety and designed for use by the physically handicapped in accordance with paragraph 2-4c(2)(f) below. Corridors should be lighted to 20 foot-candles; emergency lights should be installed to provide lighting in case the main power fails. Floor coverings should be durable, skidresistant, and easy to maintain. The maximum length of unbroken corridors should not exceed 150 to 200 feet; longer sections give an undesirable perspective.
- Restroom, Drinking Fountains, Mechanical/Electrical Closets, and Janitors' Closets should be located at corridor intersections. Because of the additional corridor space available at these points, access to such facilities will not disrupt main circulation patterns. Furthermore, since corridor intersections are also nodes for utility distribution systems (see paragraph 5-4a(2)), the necessary plumbing and electrical wiring for these facilities are readily available.
- Room Exits. All doors should be at least 3 feet wide. They should open in the direction of an exit, and be recessed so as not to protrude into the corridor when they are opened. The path of travel should be clear and level for 6 feet on the pull side of a doorway; the floor should be clear and level for at least 4 feet on the opposite side. On the pull side of the door, the floor should extend at least 18 inches beyond the doorway strike jamb. The door to toilets may be deleted, if the design permits. (Figure 2-13).
- Stairs shall be designed on the basis of a flow rate of 12 persons per foot of stair width per minute. This will produce stairs which maintain a comfortable flow rate. For example, in Figure 2-14 the stairs are designed for a circulation load of 250 people. The two 5 foot wide stairs will provide for 120 persons per minute; thus the entire occupancy could be transported between stories in slightly over 2 minutes. In a three-story building of the same floor plan, a little more than 4 minutes would be required. This is sufficiently rapid for normal service school requirements.
- Elevators. Multi-level school buildings may be equipped with combination freight and passenger

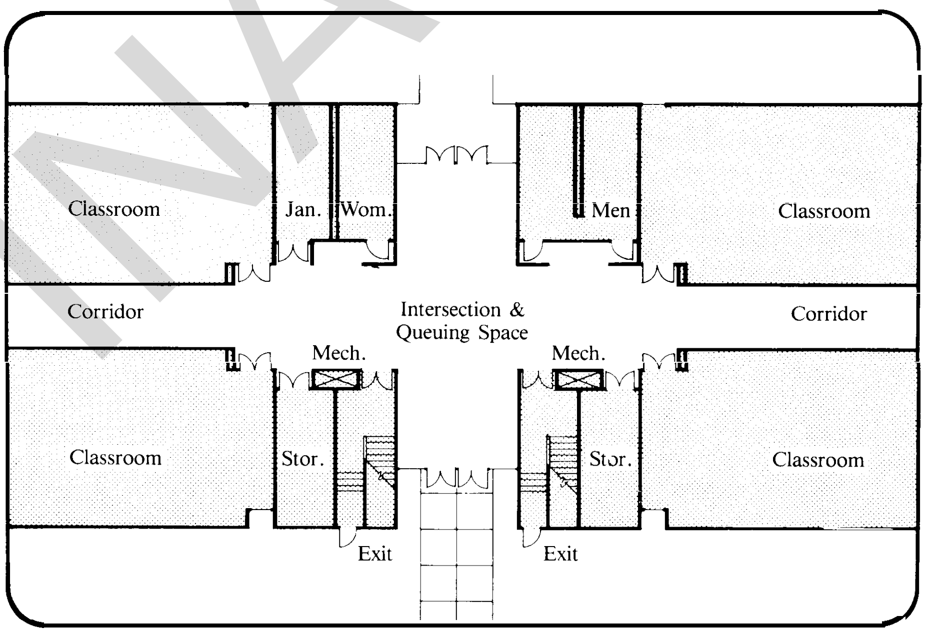
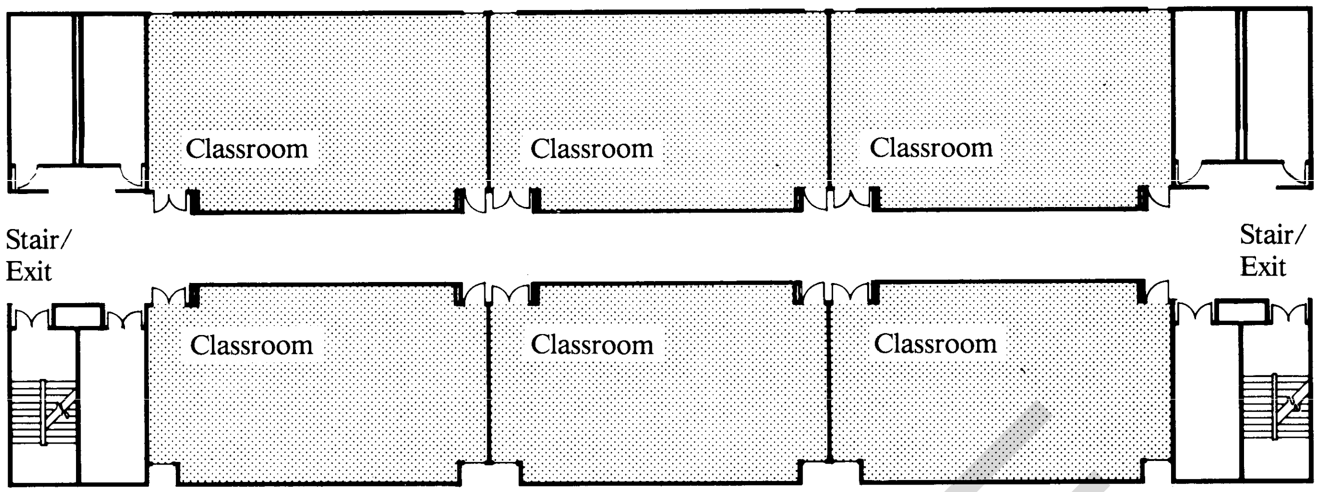


Figure 2-13
Corridor Intersection



1500 Sq. Ft. Classroom
6 X (1500 Sq. Ft.) — 9000 Sq. Ft.

Figure 2-14
Group of Classrooms.

elevators when necessary to move heavy or bulky materials between floors. Use of passenger elevators will be kept to the minimum necessary to meet operational requirements.

f. Use by Physical Handicapped.
The building must be accessible to and usable by the physically handicapped in accordance with AEI - Design Criteria, Chapter 7. Buildings should be organized in the early stages of design for access and use by handicapped civilian employees, visitors and students. For the most part handicapped persons should be able to act independently in order to pursue opportunities which would normally be afforded able-bodied persons.

g. Energy Conservation.
The basic elements of conservation design include:

- Building Shape. Heat gains and losses in a building are directly proportional to the area of its exterior. Therefore in climates which require a great deal of heating or cooling energy, multi-story buildings, which increase floor space per unit area of exterior surface, should be provided unless incompatible with functional requirements.
- Wall Shading. A substantial proportion of the air conditioning requirement for most buildings results from solar energy absorbed by building surfaces. By simply shading those postions of the building receiving the most sun, cooling requirements can be significantly reduced. Methods of wall shading which should be considered include applying various forms of canopies or louvers to the walls, and deciduous trees. Each wall of the building may require a different treatment depending upon its orientation to the sun.
- Control of glass areas. In cases where the shading methods mentioned above are not practical, the choice of window glass becomes important. At a radiation angle of incidence of 40 degrees, ordinary glass admits 85% of the solar thermal energy that strikes the glass surface, while reflective glass admits 63%, heat-absorbing glass 60%, and certain specialized glasses as little as 28%. Windows may also be recessed as illustrated in Figure 2-16. Such a design shades the window glass, substantially reducing the amount of solar energy striking the glass surface. These alternatives shall be considered in the life cycle cost analysis.

h. Color.
Use of color in Army facilities is limited to a practical number. Appendix A discusses color and notes where to get example color schemes.

i. Finish Materials.
Interior finishes must be appropriate for the designed function of the building and spaces. Selection of materials should be based on low maintenance qualities considering the anticipated use, life cycle cost impact, fire and other safety requirements. Decisions concerning the extent of carpet installation must be coordinated with the using service and should be based on distinct functional advantages, such as acoustics, safety and maintenance. The color, texture and pattern of materials should complement the overall building design. Native (local) materials should be used to the greatest extent practicable. Long-life materials such as stones, tiles, woods, plastics, and vinyls should be selected to provide attractive colors, textures and

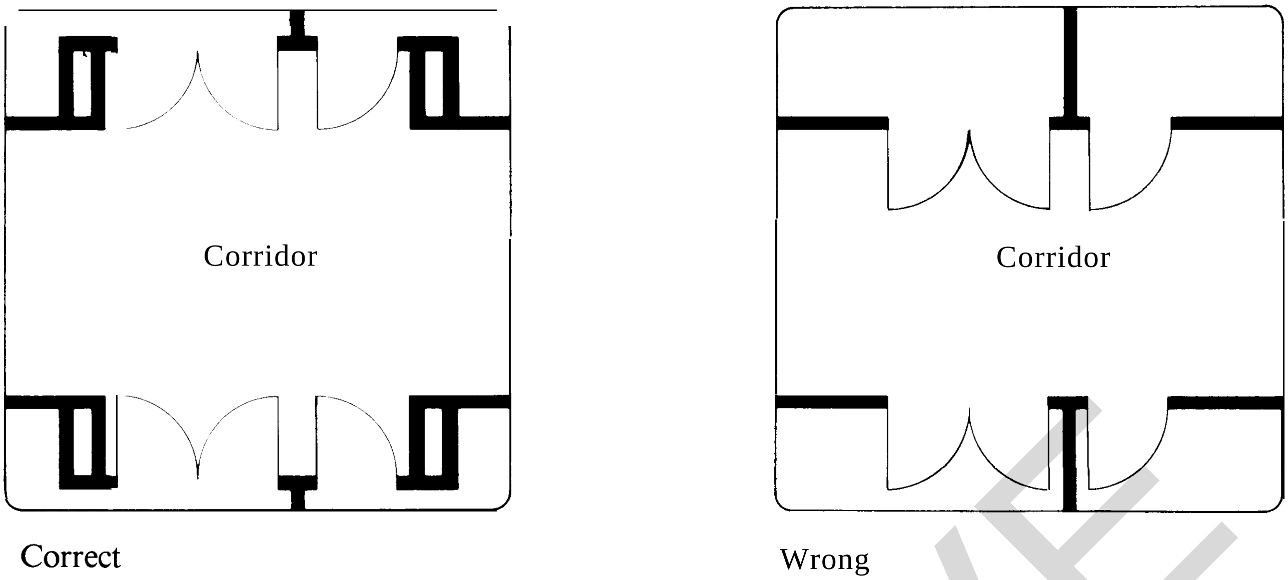


Figure 2-15
Recessed Room Exit.

patterns that will not quickly become out-dated. Interior finishes must conform to the flame spread and smoke development standards contained in AEI - Design Criteria and NFPA 101. Painted surfaces and patterns are relatively easy and inexpensive to refurbish and can be kept fresh and up-to-date in appearance. The following items should be considered for reducing maintenance on all buildings: sealed concrete floors, removable carpeted elevator floors, entrance mats, cove bases at all floor/wall connections, hard-finish (glazed concrete block, ceramic tile, etc.) walls, wall corner guards, push plates, and large metal kickplates on doors. Guidance for interior design may be obtained from DG 1110-3-122.

j. Wall Graphics.
While mainly decorative, such graphics may frequently incorporate floor numbers, directional indicators, safety markings, Army insignia, and so-on. When professionally done, they can be most effective in livening up dead spaces and producing interest such as in large rooms or circulation spaces.

k. Signage.
Signage must be specified as an overall system, coordinated with exterior and interior signage prescribed in TM 5-807-10. The system should assure maximum economy, ease of procurement and installation, and standardization of application throughout the building. It must inhibit vandalism but be flexible enough to allow addition or deletion of information. The use of pictographs instead of words is recommended.

i. Safety Markings.
The locations of exits, fire protection and other safety equipment should be strongly emphasized as appropriate. Safety markings (signs for danger, warning or caution) should be designed in accordance with AR 385-30, Safety Color Code Markings and Symbols. Use pictograph sign panels approximately 12 inches square for Danger, Warning or Caution signs (Electrical hazard, etc.).

m. Storage.
Care shall be exercised during the planning and designing of Service Schools to identify the number, size and type of storage areas required. Inadequate storage provisions may result in general purpose classrooms becoming "dedicated" because of a requirement to keep rooms locked to protect equipment.

Two factors which effect the design of storage are the physical characteristics and frequency of use of materials to be stored.

- Whenever possible training equipment should be portable or movable.
- When indicated by the mission, provision shall be made to allow for movement of large, mobile equipment such as tanks, helicopters and military vehicles between classrooms and outdoor storage areas.
- Large equipment that is infrequently used and is not readily moved should be blocked from view by movable partitioning when not in use.

- Large and medium size equipment that is in daily use should be stored in place in dedicated shops and classrooms.
- Medium-sized equipment that is not in daily use, such as engines and mechanical assemblies, should be placed on dollies and stored in lockable spaces within 75 feet of the classroom.
- Light, hand-carried equipment should be stored in lockable spaces within 75 feet of the classroom. If such equipment is in daily use, storage should be provided in lockers in the classroom or in a room directly adjacent to the classroom.
- Special considerations such as environmental control and security shall be incorporated when necessary.
- Utilization of multi-purpose space developed for classroom use and divided to make provision for storage shall be given preference to construction of single use storage space.
- Adequate, secure storage for instruction materials, training aids, and audio-visual equipment should be planned for and located where needed. A general rule is to provide 1 1/2 square feet per student (this assumes that storage will be four shelves high).
- Space should be available to store outer clothing (coat racks) and other personal equipment within or near each training, work, or study area.
- Adequate filing space for learning materials can be provided by a sufficient number of filing cabinets or built-in storage selected and arranged for easy access within the learning space.

n. Security.
Security requirements and restrictions may differ for each Army Service School according to individual course content, materials, and equipment. The military commander of the installation or facility is responsible for designating and establishing "restricted" areas. Advice is furnished to him/her by the provost Marshal or Physical Security Officer, in coordination with the Intelligence Officer and the Staff Judge Advocate. "Exclusive," "limited," and "controlled" areas should be designated according to AR 380-20, AR 310-25, AR 50-5, and AR 190-21.

o. Adequate Area.
To make an initial planning decision, the school planner must have some idea of how much area to provide for mechanical space. To determine the amount of mechanical space required, multiply the net floor area by 0.05. For example, a facility with a net floor area of 13,300 square feet would require 665 square feet for mechanical equipment: 13,300 x 0.05 = 665 square feet. This area should be listed separately on the DD Form 1391, below the scope.

(3) Structural.

a. Selection.
Loads and criteria must be in accordance with AEI - Design Criteria and TM 5-809-1 through 6, 8 through 11. The structural systems and materials selected must

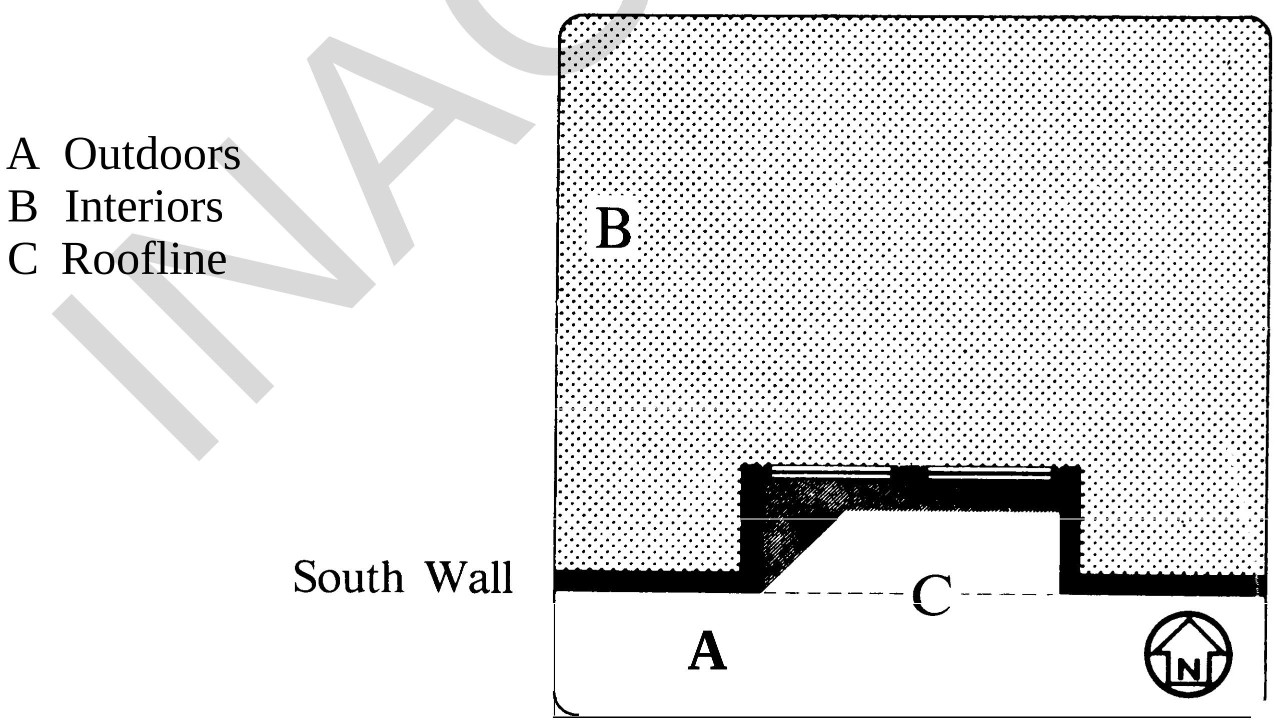


Figure 2-16
Glass Shading, South Elevation.

be suitable for permanent type construction, be capable of carrying the required loads, and be compatible with fire protection requirements and architectural and functional concepts. The structural system and features selected should be that system which is the most economical and suitable based on comparative cost studies for the building. Comparative cost studies should be made for the three most apparent competitive systems and take into account mechanical, electrical and other features where they vary between systems under study.

b. Versatility.
Due to changing instructional programs, the structure should be designed so that spaces within the buildings can be utilized for different purposes without sustaining the cost of major alterations. Bay or module spacing should be adequate to give the desired flexibility and convertibility in view of the interacting structural, mechanical and electrical elements involved. Structural design should include rigid framing connections to eliminate need for shear walls within blocks of activity space. Design loads for floors in non-dedicated classrooms should be uniform.

c. Protective Construction.
In locations where a deficit in PF 100 fallout shelter space exists under the Army Survival Measures Plan, described in AR 500-72, selected areas of the structure should be designed for dual use as fallout shelters. Technical and other requirements should be be accordance with TM 5-800-1, Construction Criteria for Army Facilities. Single-line plans showing locations, occupant loads, and minimum protection factors for the selected shelter areas must be included in project design analyses and completion records.

(4) Plumbing.

a. Selection.
Plumbing must be in accordance with TM 5-810-5 (and TM 5-810-6 if gas fittings are required). Water supply facilities must be as prescribed in TM 5-813-5 and 6. Sanitary sewers must be as prescribed in TM 5-814-1. Plumbing and fixtures shall comply with the "American National Plumbing Code A 40.8" or the "National Standard Plumbing Code", within the limits established by AEI - Design Criteria, Chapter 15.

b. Latrine Location.
Both female and male latrines shall be provided near administrative areas and on each floor of classroom wings, so as to allow for convenient use by staff and students.

c. Specifications.
Applicable CE Guide Specifications include the CE 300, 500 & 600 series.

(5) Mechanical.

a. Selection.
Heating, air-conditioning and ventilation must be in accordance with current AEI - Design Criteria and TM 5-810-1. The heat loss and heat gain calculations must be made in accordance with the current ASHRAE Handbook of Fundamentals. In the design of air-conditioning systems, various systems should be considered such as variable air volume, multizone, dual duct, single zone, a combination of systems and any other suitable systems covered by the current ASHRAE Handbooks. Within the design scope and environmental conditions required for various spaces, each air-conditioning system should be studied and the least energy intensive system selected based on life cycle cost and the energy analysis. Energy recovery systems should be investigated and incorporated into the design if economical. Reasons for selection and rejection of systems must be included in project design analyses.

b. Specifications.
Applicable CE guide specifications include the CE 301 series.

(6) Electrical.

a. Selection.
Electrical Design must conform to AEI - Design Criteria and TM 5-811-1 through 4. System characteristics should be selected to provide the most efficient and economical distribution of energy. Voltages selected should be of the highest order consistent with the load served. Three phase 208Y/120 volts should generally be used to serve incandescent and small fluorescent or mercury vapor lighting loads, small power loads, and receptacles. Consideration should be given to the use of three-phase 480Y/277 volt systems where such is feasible.

b. Lighting.
Intensities should conform to the minimum levels recommended by the latest edition of the Illuminating Engineering Society Lighting Handbook. OCE Standard Drawing No. 40-60-04, Lighting Fixtures, should be used to the maximum extent practicable. Sufficient local switching capability should be developed in the lighting design to achieve maximum and minimum lighting levels for facility operation. Such a provision should enable occupants to use maximum lighting only in that portion of the facility where it is needed, and to use a lower level of

illumination elsewhere. Where practical, lighting should be designed for specific local tasks instead of providing uniform general levels. For example, lighting for individual study carrels should be designed for a local illuminating of 70 foot-candles (the Illuminating Engineering Society standard for classroom lighting), while lighting for general room illumination need be designed for only 30 foot-candles (minimum).

c. Electrical Power Distribution.
In order to reduce line losses which occur at lower voltages, power should be distributed at the highest practical voltages. Substation transformers should be located throughout the school to reduce the voltage to 277/480 volts for fluorescent lighting, heavy equipment operation, and power distribution. A second set of transformers should be provided to step the voltage from 480 to 120/208 for convenience outlets. Primary electric service should be underground from the nearest pole or manhole to a pad mounted transformer(s) located outdoors below grade, and as close to the load centers as practicable. Secondary electric service from transformer(s) should also be underground. Service and distribution equipment should be of the circuit breaker or fusible switch type, and branch circuit panelboards should be of the circuit breaker type. Shallow closets should be provided for electrical, telephone and auxiliary system equipment, where required. Distribution of power within the building should be in trenches or overhead raceways located to afford maximum flexibility in room power requirements and ready accessibility for circuit revisions.

d. Emergency Lighting.
Illuminated exit signs and emergency lights must be provided for all emergency exits and passageways as required by the NFPA Life Safety Code No. 101.

e. Telephone System.
Building telephone service should be underground with main terminal cabinets located in mechanical or electrical equipment rooms. Telephones and lines will be provided by the local Communications-Electronics Officer. However, the building must include outlets in key areas, identified in Chapter 3, including areas reserved for public telephones. Placement of outlets and empty telephone raceway systems must be designed in conjunction with the building design, and coordinated with the local Communications-Electronics Officer. Evidence of such coordination should be provided in the project design analysis.

f. Intercom/PA Systems.
An intercommunication system must be provided, consisting of a master station capable of selectively paging through individual loudspeakers in selected areas and offices. The loudspeaker stations should be the talk-back type, and include a conveniently located master station call button. The master station should have volume controls on input and output, an all-call feature, and indicators for announcing incoming calls. Speakers should be the flush-mounted type. Medium and large size classrooms must be furnished with receptacle and wiring for microphones and speakers for amplified audio distribution.

A class bell system may be incorporated into the public address system.

g. Central Television System.
A central television antenna system may be required. Antenna outlets should be located adjacent to convenience outlets in classrooms and lounges. Conduit, terminal box, outlet and junction box locations and sizes; the choice of using either CATV or MATV system facilities, or the provision of a complete local-building-type antenna system, must be coordinated with the local Communications-Electronics Officer at the earliest practicable phase of design. Where a non-government owned antenna system is to be utilized, built-in system features such as empty conduits and pull wires, terminal cabinets, and antenna outlets only will be provided with project funds.

h. Special Features.
Special receptacles for teaching equipment and task lights, lights with dimmers and lights for platform illumination shall be provided in classrooms as required by the using agency. Other features, such as a central information phone to orient the physically handicapped, may also be required.

Computer-controlled and electronic training equipment may require special environments. Refer to equipment manuals to establish criteria and specifications for radio frequency shielding, thermal conditions, signal grounding, and power fluctuations.

i. Specifications.
Applicable CE guide specifications include the CE 303 series.

(7) Fire Safety.

a. Criteria.
Criteria for fire protection, including fire and/or smoke detection systems, fire alarm and evacuation signal systems, and extinguishment systems, are prescribed in
MIL-HDBK-1OO8A,
AEI - Design Criteria, TM 5-812-2 and TM 5-813-6. These are generally based on the National Fire Code.

Because of the large size and occupancy, as well as the nature of equipment contained in many schools, fire safety will impact heavily on the organization and design of the buildings. The area limitations, length of corridors, size of rooms and exits must conform to the requirements for "flexible plan" buildings given in the National Fire Protection Association Code NFPA 101. Single-line plans showing fire-rated construction, location of detection and alarm systems, the location of exists and evacuation routes, areas where sprinkler and/or extinguishing systems are provided, and the location of other fire protection features must be included in project design analyses and completion records. The fire safety design should also be coordinated with the installation fire marshall.

b. Automatic Sprinkler Systems.
Automatic sprinkler systems must be provided:

- In all portions of educational buildings located below the floor of exit.
- In all windowless classrooms, shops and educational spaces not having exits leading directly to the outside.
- In all shops and classrooms in which hazardous materials are handled.

c. Extinguishing Systems.
Special extinguishing systems may be provided for protection of specific occupancies where such systems are determined to be the most feasible and effective.

d. Protection of Special Devices.
Space where special electrical or mechanical devices such as computers, simulators, etc., are to be housed must be identified and extinguishment systems designed accordingly.

e. Specifications.
Applicable CE guide specifications include CE 710.03 for fire alarm and evacuation signal systems, and CE 700 for sprinkler systems.

(8) Drawings.
Design drawings should show as a minimum, floor plans indicating functional layouts with all rooms and spaces dimensioned, elevations indicating type and extent of exterior building finishes, cross-sections with floor to floor heights dimensioned, specification of materials and methods of construction, design of electrical, mechanical and structural systems, communications and fire safety design, and interior designs with schedules of finish materials.

D. Interior Design

(1) References.
Final selection of equipment and furnishings must be based on the 1391 estimate and Project Development Brochure completed during planning as discussed under paragraph 2-3d. All items of equipment and furnishings which are permanently built-in or attached to the structure, as defined in AR 415-17, are considered part of the building. Other items which are loose, portable or can be detached from the structure without tools, are generally provided by the using service under separate contract.

DG 1110-3-122 shall be used as guidance in the development of the project. During final selection, preliminary schedules should be reviewed carefully, coordinated again with the local using service, and verified against the latest mandatory source catalogs.

(2) Selection Factors.

a. Appearance.
Furniture is an integral part of the overall building design and should be closely coordinated with the selection of colors and finish materials for consistency in appearance and quality. Clear relationship between the furnishings finish schedule and the building finish materials should be evident.

Chapter 4 of this guide gives the school planner information useful for selecting furniture. Color and finishes are included with overall color and texture schemes (Appendix A). Other characteristics are covered within space types for furniture appropriate to it. The Directorate of Information Office (DIO) can help the school planner find out what furniture is available to the school. DIO maintains a current list of Government contractors for furniture items, and may have or can obtain contractor's catalogs.

b. Durability, Comfort and Safety.
Careful attention must be given to all interior furnishings to insure that the type of furniture chosen conforms to standards of durability, comfort and safety appropriate for the use they will receive. Being generally mobile, furniture items are subject to handling. parts that receive the most wear should be replaceable, and finishes should sustain regular cleaning. Colors, textures, sizes, proportions, shapes and reflections are important comfort factors that should be considered. Furniture and equipment must withstand loading conditions without damage. Edges and surfaces should be smooth and rounded. Materials must be flame-retardant.

c. Mobility and Interchangeability.
Most interior furnishings should not be of a scale which would require more than two persons to relocate them, or be so complicated as to require an undue amount of time to assemble or disassemble.

Whenever possible, care should be taken to choose multi-purpose furnishings aesthetically suitable for a variety of needs and activities. Stackable and foldable furniture should be considered for reducing bulkiness in storage and transport where such requirements exist.

(3) Drawings and Schedules.
Furnishing layouts and schedules must indicate items which are part of the building and items which must be procured under separate contract. Drawings and schedules must be in formats that can be readily understood by installation personnel who are responsible for procurement and component placement and utilization after delivery. Display sheets consisting of placement plans, catalog illustrations, material/color samples and perspective sketches of typical spaces, together with procurement lists, source data and cost estimates should be developed as appropriate to accomplish this objective.

2-5 Provision of User Information

A. Requisites.
The completion records required upon completion of a building project are delineated in AR 415-10.

Additional requirements for user information are established in ER 1110-345-700, Design Analysis. The user information supplement to the completion records must include information on how to best utilize the facility design. Information must be presented in a form that facilitates understanding and use by using service personnel and Facilities Engineer personnel.

B. Site Design Information.
An activity layout plan should be provided to show the operational aspects of using the site, along with a discussion of the parking and traffic loads (with notation concerning sources and dates of traffic studies conducted), intended procedures for snow and trash removal, grounds control and security operations, and provisions for future expansion of parking, buildings, utilities, streets, etc. Aspects of planting care with a program for feeding and maintenance is also recommended.

C. Building Design Information.
This should include an activity layout plan along with a discussion of methods for altering partition systems and environmental systems, restrictions and maintenance required by fire safety regulations, intended levels of operation and control of environmental systems, necessary security and safety procedures, and aspects of housekeeping and maintenance. Fire safety plans and protective construction plans should also be provided along with a description and/or plan of features for the physically handicapped.

D. Technical Information.
All technical information available from manufacturers of the materials, equipment and accessories incorporated in the facility, will be provided to facilitate successful maintenance and operation of the facility. Similar information on special equipment and furnishings should also be provided.

3-1 General

This chapter discusses Special Considerations related to modular design, lighting design, acoustic design, design of the thermal environment, seating design and design of audio-visual systems. The material in this chapter is intended to establish special requirements and criteria in conjunction with the individual space criteria in Chapter 4.

3-2 Modular Design

A. Characteristics.
As previously noted, service schools are characterized by frequent changes in instructional program and student load, and by a requirement to be capable of rapidly expanding school operations. The characteristics require a school design which emphasizes flexibility in room use and provides for ease of expansion. The primary classroom requirement at U.S. Army Service Schools is for spaces that will:

- Seat 24 to 48 students.
- Be easily convertible to other uses.
- Minimize disruption of activities during modification of use.

B. Standard Space Module.
Based on the classroom requirements above, the optimum activity space module for service schools is 30 ft. x 50 ft. (Figure 3-l). This 1,500 sq. ft. space:

(1) Provides ample seating for 50 students at 2 ft. x 3 ft. tables (the most commonly used student situation) in the proper dimensional proportions for conference/lecture activities.

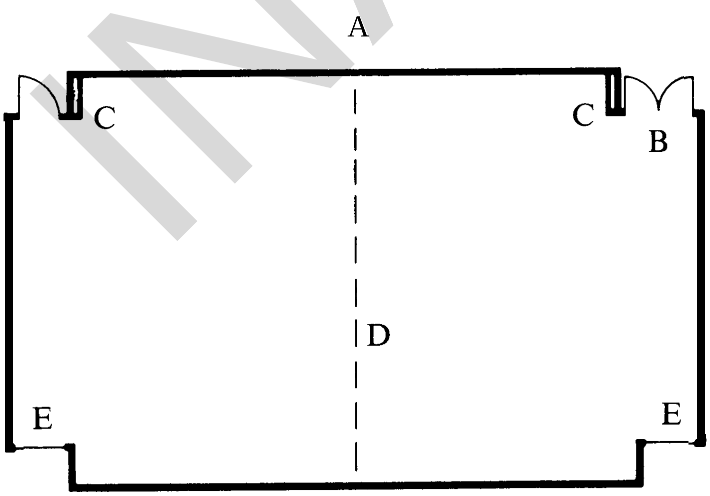
(2) Is easily divisible, by fixed or movable walls, into two 25 ft. x 30 ft. (750 sq. ft.) rooms for 25-student classes.

(3) Can be constructed around the 5-ft. dimensional planning unit. (This dimension readily accommodates the standard 4-ft. fluorescent tube and reduces the number of different-sized wall panels needed for construction. See Chapter 5 for additional information on the 5-ft. planning dimension).

C. Modular Arrangement.
The standard space modules should be employed in 30 ft. wide bands along double loaded corridors. (Figure 3-2). This pattern maintains the proper classroom proportions in both the 1,500 and 750 sq. ft. spaces, reduces circulation time by minimizing overall corridor length, and conserves heating and cooling energy by minimizing external wall areas. Moreover, it provides a building pattern which readily accommodates changes in function.

D. Functional Flexibility.
Modular spaces can serve as classrooms, seminar rooms, labs, self-paced learning carrels, instructor preparation spaces, training aids storage areas, and administrative offices with only a change of furniture and the positioning or repositioning of partitions. (Figure 3-3).

E. Interior Wall Systems.
Only the exterior and corridor walls of the modular space banks need be permanent; transverse walls may be either semi-permanent or movable partitions. Semi-permanent walls should be erected in those areas in which a minimum of functional change is anticipated; e.g., in administrative areas. Movable partitions should be employed in those spaces in which changes in



A Corridor
B Double Doors for Equipment
C Utilities Chase
D Typical Partition Location
E Window

Figure 3-1
Repetitive General Instruction Space

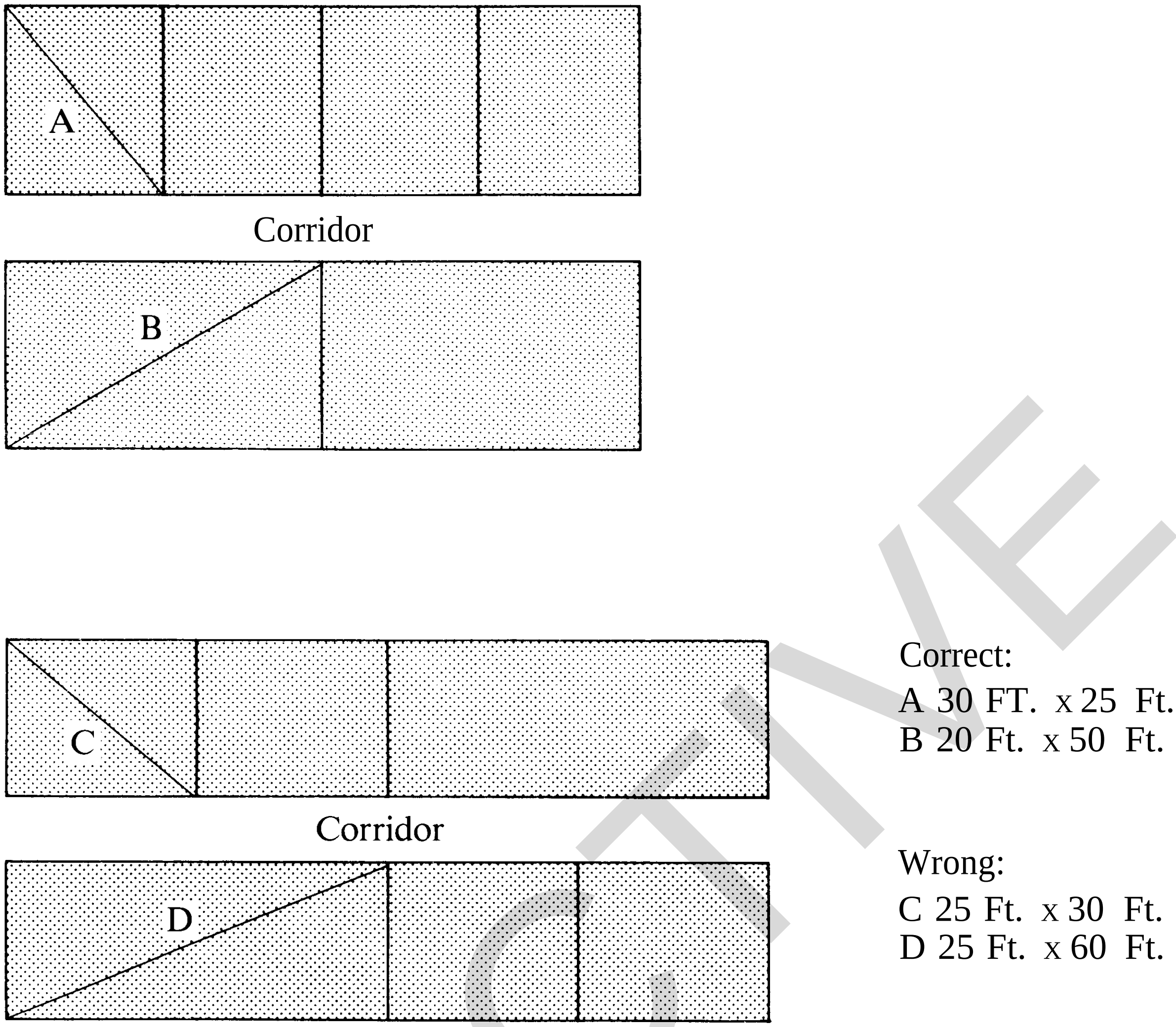
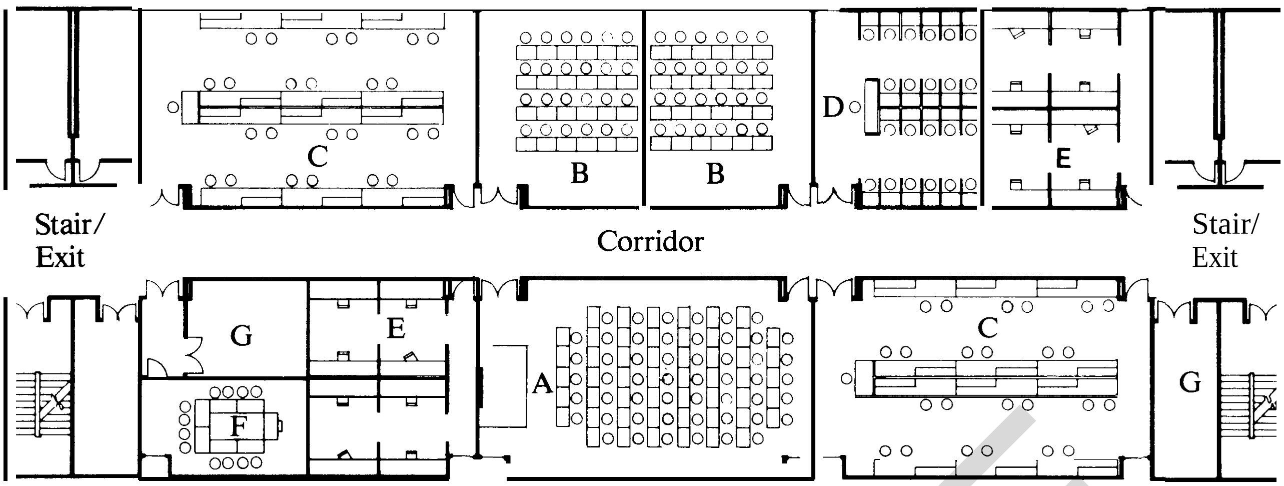


Figure 3-2
Arrangement of Repetitive Space

function or class size are relatively frequent. Figures 3-4 and 3-5 show some of the basic characteristics of the most common types of movable and semi-permanent interior wall systems. The designer must develop an accurate estimate of the frequency of functional change in a given space, and on the basis of that estimate select an appropriate interior wall system.

F. Partition Systems.
Low height partitions may be used to sub-divide major activity spaces into such areas as self-paced learning carrels, instructor preparation spaces, and administrative offices. The primary consideration here is the degree of interaction desired between work stations. The height of the partition and the amount of enclosure should be matched to the level of interaction desired. For example, some activities are largely individual tasks requiring little outside communication; e.g., self-paced learning, instructor preparation. In these situations, partitioning must be high enough and complete enough to minimize distractions. Other activities, such as administrative staff planning, require spaces with little or no partitioning so as to promote group interchange. Partitions will be used in this case only to contain the group and reduce interference between it and adjacent groups.



A 50-Student Classroom
B 24-Student Classroom
C 24-Student Lab
D Study Carrels
E Instructor Preparation
F Seminar Room
G Storage

Figure 3-3
Multiple Use of Repetitive Space

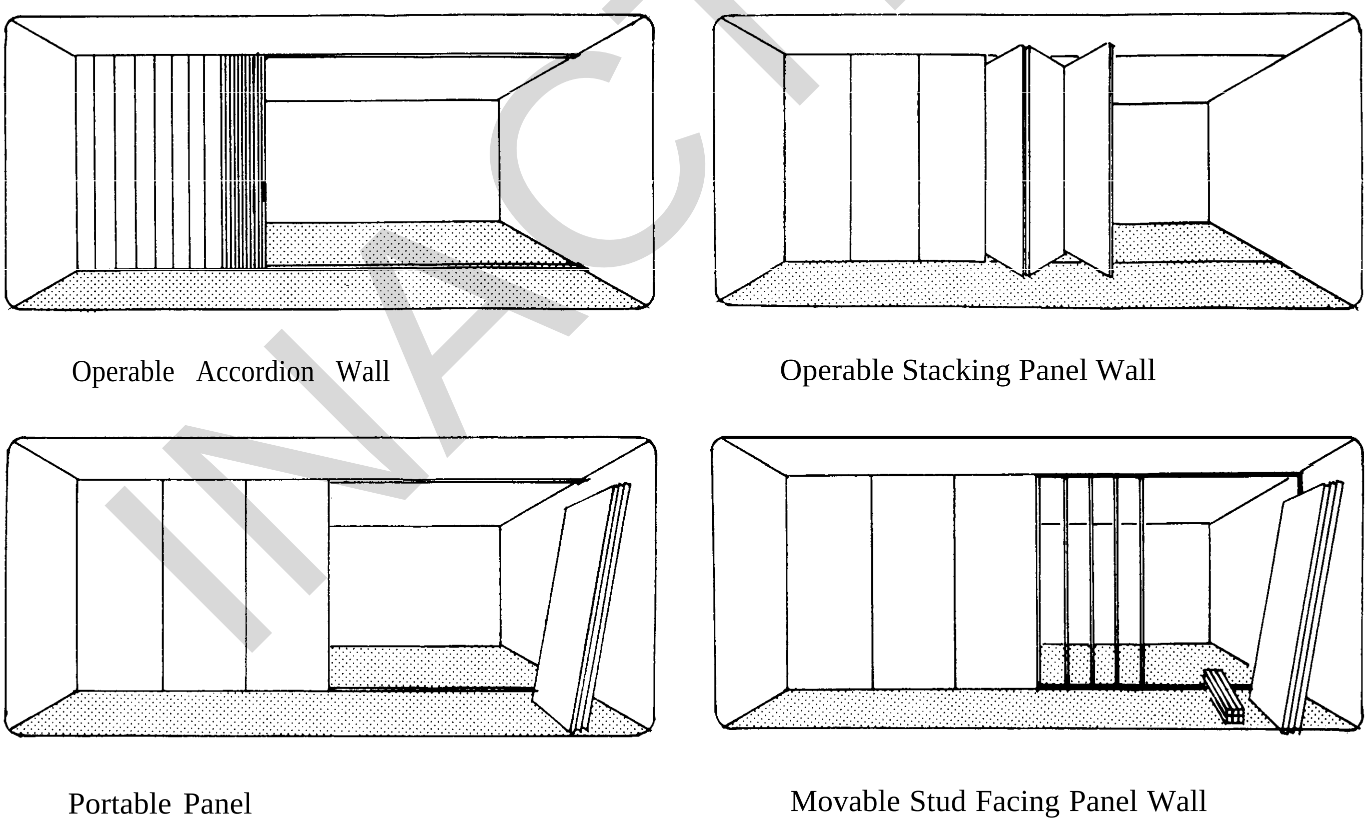


Figure 3-4
Changeable Wall Systems

Partition Type	Relative cost	Change Frequency			
		Hourly	Daily	Monthly	Yearly
Fixed (non-load bearing) 6 " CMU 6" GWB	1	No	No	No	Yes
Moveable	1.8	No	No	Possible	Yes
Accordian	2.6	Yes	Yes	Yes	Yes
Portable	3.2	No	Possible	Yes	Yes
Folding Panel	5.4	Yes	Yes	Yes	Yes

Figure 3-5
Change Frequency and Cost of Wall Systems

G. Support Systems.
For flexibility in the use of modular spaces, mechanical and electrical systems must be designed to adapt to changes in room function. Specific considerations include the following:

(1) Separate lighting controls shall be provided for each 750 sq. ft. space. These controls should be located near the entrances to provide separate control of the two 750 sq. ft. component spaces within.

(2) In addition to meeting the visual criteria prescribed below, room lighting should be designed to provide flexibility in lighting levels and arrangements. Lighting should be capable of being adjusted to classroom activities (uniform 70 foot-candle illumination), self-paced learning (uniform background illumination of 30 foot-candles, local task illumination of 70 foot-candles), and audio-visual presentations (screen area darkened, other areas at 30 foot-candles).

(3) The lighting design should also be easily adapted to spatial divisions other than two 750 sq. ft. areas.

(4) All activity spaces should be provided with mechanical chases at door recesses. These chases should be easily accessible, of sufficient size to allow additions to services and should feature an electrical distribution panel on the corridor side and a chase panel on the room side with connections to ceiling and intra-wall conduit runs.

(5) The minimal wiring distribution system must provide signal and line voltage power. Depending upon the instructional program, additional power distribution may be required for unusual voltage, phasing, or frequency demands.

(6) Each 750 sq. ft. space should have separate temperature controls. Subdivisions other than 750 sq. ft. spaces will require room heating and cooling system revisions. These revisions must be economical and simple to accomplish.

3-3 Design of Learning Environment

A. Balanced Sensory Stimulation.
The functional and learning capabilities of students are influenced by the sensory stimuli of their environment. Providing the appropriate sensory background for a positive learning environment is not a matter of simply minimizing sensory stimulation. There are optimum levels of stimulation to complement learning activities. For example, a background noise level of approximately 35 decibels of full-spectrum or "white" sound produces optimum alertness and muscle tonus for learning. It has also been shown that people hear

and understand best when the illumination level is high enough to provide a clear view of their surroundings. On the other hand, too much sensory input of any sort distracts the student and causes an inordinate amount of his energy to be expended in filtering out the extraneous input. The sensory stimulating aspects of the environment must therefore be balanced so as to conserve the student's energy, while at the same time providing the necessary stimulation to promote the optimum physiological and psychological conditions for learning.

B. Lighting Design.

(1) Visual Considerations.
An appropriate visual environment with adequate lighting is essential for effective learning. A well lighted classroom enhances auditory as well as visual perception. In the case of a large space not provided with a sound amplification system, lighting is an important factor in the ability of the audience to hear the speaker. Audio-visual aids have traditionally been used in darkened rooms; however, audio-visual devices designed for use in lighted rooms are more effective.

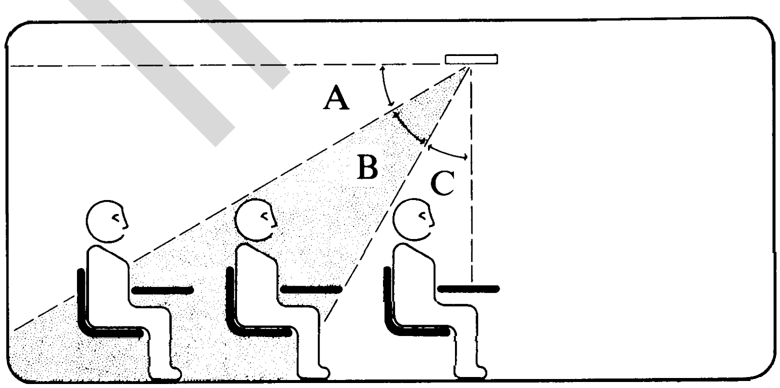
(2) Quantity of Light in Instructional Spaces.
Research has established that a lighting level between 30 and 50 foot-candles is adequate for the comfortable and efficient completion of most tasks. However, it is recommended that illumination be designed to supply 70 foot-candles on all educational tasks, since accurate reading of pencil handwriting demands higher illumination levels than most other visual tasks. Lighting levels higher than 70 foot-candles are not required.

(3) Quantity of Light in Circulation Spaces.
In lighting circulation spaces, an important consideration is the ability of the eye to adapt to light and darkness. Only 35 seconds are required for partial, yet safe, adaptation when moving from a dark space to a lighted area. When moving from light to dark, however, minimal adaptation requires two minutes, total adaptation up to half an hour. Since personnel entering the service school facility will be coming from the outdoors, where the level of illumination may be anywhere from 2,000 to 5,000 foot-candles, it is important to provide adequate lighting in circulation spaces. Foyers will be bright to permit gradual adaptation to the interior lighting level. Staircases should have high-intensity lighting to outline steps, handrails, and other important elements and show clearly the stair's configuration.

(4) Quality of Light.
The quality of light is even more important than the quantity. Critical factors here include:

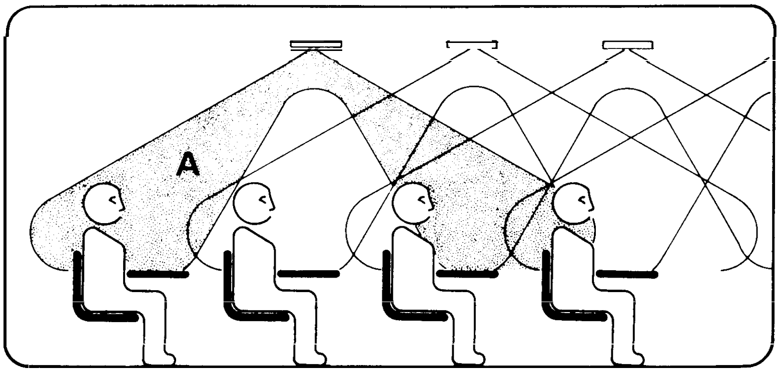
a. Lateral Differences in Illumination.
When personnel are placed in an environment in which illumination on either their left or right is significantly greater than that on the opposite side, their eyes are subjected to distracting and uncomfortable stresses. This situation often occurs in classrooms in which windows allow light to stream in from one side of the students' field of vision. Such conditions can be avoided by designing the seating so that the windows are behind the student or, when this is not possible, by moderating the entering light with shading or other light-attenuating devices.

b. Task-Background Illuminating Levels.
In general, the task (paper, book, item of equipment) confronting the student should be brighter than the surrounding environment. For optimum contour and depth perception, it should be three times as bright. Contrasts greater than this produce distortions. In no case should the task illumination level exceed ten times the general lighting level.



A 0 Degrees — 30 Degrees Fixture Glare
B 30 Degrees — 60 Degrees Optimum Light
C 60 Degrees — 90 Degrees Veiling Reflections

Figure 3-6
Lighting Glare and Reflections



A "Batwing" Distribution

Figure 3-7
Lighting Without Glare

c. Veiling Reflections.
Lighting shall be designed so as to minimize veiling reflections; that is, light which is reflected off the task or nearby surfaces directly into the student's eyes. In general, this involves selecting and placing the light fixture so that the angle of incidence measured from the vertical is greater than 30 degrees, with as much light as possible falling within the 30 to 60 degree core. (Figure 3-6).

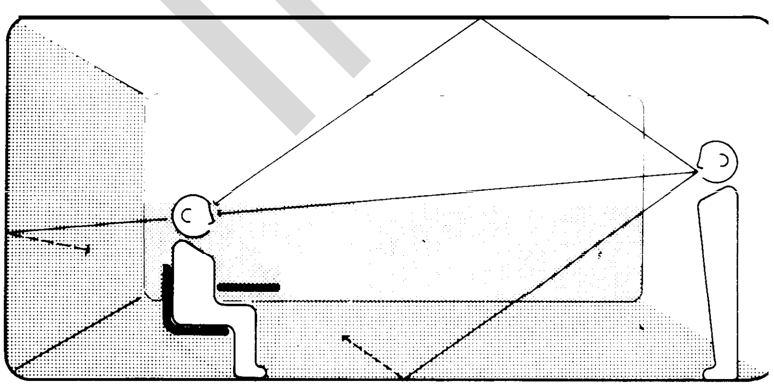
d. Glare.
Lighting design shall also minimize glare; that is, light which shines directly from the light source into the student's eyes. This can be accomplished by selecting and placing light fixtures so as to direct the light below a 60 degree angle of incidence, with, again, as much light as possible falling in the 30 to 60 degree core. Lighting fixtures with low brightness characteristics that produce a "bat-wing" light distribution pattern are one means of satisfying this requirement. (Figure 3-7).

e. Audio-Visual Presentation.
Lighting design for A-V presentation is discussed in 3-4.f.

C. Acoustic Design.

(1) Terminology.
Three terms are common to basic discussion of acoustic design in Service Schools: Decibel (db), Noise Reduction Coefficient (NRC) and Sound Transmission Class (STC). Decibel is a measure of intensity of sound related to its subjective loudness. For measuring ordinary sounds, a decibel level of zero represents the faintest sound audible to the average person. Normal voice conversation is approximately 60 db to 80 db. Noise Reduction Coefficient is a mathematical average of sound absorption coefficients recorded at the frequencies of 250, 500, 1,000 and 2,500 cycles per second. The use is to quantify sound systems for comparison. Sound Transmission Class is a rating based on standardized test performance for evaluating the effectiveness of assemblies in isolating airborne sound transmission. A frequency range of 113 to 4,450 cycles per second is included for the standardized test.

(2) Maximum Sound Level.
Loud and sustained noise can be a hazard to hearing. The safe limit for an unprotected ear is approximately



Sound Reflective Surfaces Indicated in White

Sound Absorptive Surfaces Indicated in Tone

Figure 3-8
Room Sound Control

135 decibels. At 150 decibels even short-term exposure may cause damage. These facts have important implications for the design of shop areas, where high intensity noise is frequently a problem. The designer must provide some means of attenuating shop noises to protect the hearing of students and shop personnel.

(3) Acoustic Considerations.
The key to providing an acoustic environment conducive to learning consists of controlling background noise while at the same time reinforcing the projection of the instructor's voice.

a. Background Noise.
Background noise other than the white noise discussed in paragraph 3-3a above is distracting. As the background noise level rises, the difficulty of hearing increases. This masking effect is greatest when the frequency range of the desired audio stimuli and the background noise are similar. For example, voice noise of 35 db is more disruptive than mechanical ventilation noise of 35 db.

b. Reflective and Absorptive Surfaces.
In order to reinforce the instructor's voice and help eliminate distracting reverberations in the classroom, the ceiling, the wall behind the instructor, and the upper half of the side walls should be provided with sound reflective surfaces. The remaining surfaces of the room should be sound absorptive so that noise generated close to the floor (e.g., dropping objects, scuffling of shoes, or the moving of chairs) is reduced. (Figure 3-8).

D. Design of Thermal Environment.

(1) Thermal Considerations.
A controlled thermal environment is another important factor in designing comfortable, safe, and effective instructional spaces. Control of the thermal environment includes the following considerations. (For specific requirements related to control for the thermal environment, see Chapter 4, Individual Space Criteria.

a. Temperature is the most important element of the thermal environment. In designing for temperature control, the temperature of surrounding surfaces, as well as that of the air, must be taken into account.

b. Humidity determines the evaporation rate at a given air temperature and thus affects human body temperature by limiting the amount of natural evaporative cooling that can take place. The higher the humidity, the less heat the body can dissipate through perspiration.

c. Air Composition refers to the relative amounts of oxygen, carbon dioxide, and other gases, as well as airborne particles such as dust, pollen, and bacteria, which make up the room air. The composition of the air greatly affects the comfort and safety of building occupants and hence must be controlled.

d. Air motion is an important thermal consideration because it influences the rate of body heat transfer. The higher the air velocity, the greater the rate of body heat loss.

(2) Human Performance and the Thermal Environment.
Investigations in the area of human performance show that when temperature and humidity become high, working efficiency decreases, errors increase, and under extreme conditions health is adversely affected. In areas such as shops, in which students are working with equipment and machinery, temperature control devices should be provided for safety purposes.

a. Temperature Control.
Whenever the daytime outside temperature is above 55 degrees F., heat gains will usually outweigh losses. Therefore the fundamental problem in controlling the thermal environment in a service school is cooling, rather than heating, the facility. The desirable temperature for a building depends on the activity of its occupants. Acceptable temperature limits vary from 60-70 degrees for vigorous activity to 68-78 degrees for sedentary activity. In a service school, where learning activities range from sedentary to vigorous, separate temperature zoning should be provided. For example, shop areas should be zoned for a lower temperature than classrooms or administrative areas.

b. Humidity Control.
This generally is not necessary. Relative humidity has little influence on comfort, provided that it is in the intermediate range (30% to 70%). Humidity levels above 70% can impair human performance and levels below 30% can cause respiratory discomfort and create undesirable levels of static electricity in activity spaces.

c. Air Composition.
This should be carefully controlled. In a closed, occupied space, the amount of oxygen in the air decreases and the amount of carbon dioxide increases. Normally, ventilation sufficient for the removal or dissipation of odors is also adequate for maintaining the proper balance between oxygen and carbon dioxide. Dust, pollen, and bacteria should be eliminated by air filtration.

d. Air Motion.
This is another factor requiring control. Air distribution systems should provide uniform air

velocities generally not exceeding 40 feet per minute for an air-conditioned draft-free environment. If the building is not air-conditioned a higher air velocity increases summer thermal comfort.

E. Seating Design.

(1) Instructor-Student Visual Contact.
Arranging seating to facilitate instructor-student visual contact is of primary importance. Students sitting directly in front of the instructor participate significantly more than students sitting off to one side. Seating arrangements should therefore encourage direct visual contact between instructor and students. (Figure 3-9). In a classroom containing several rows of seating, a speaker's platform is required; in a large conference room or an auditorium, tiered risers for student seating are required.

(2) Seating Comfort.
Seating which is too comfortable may discourage student participation and alertness. Seating should be selected which is reasonably comfortable, but not so relaxing that it encourages inattentiveness.

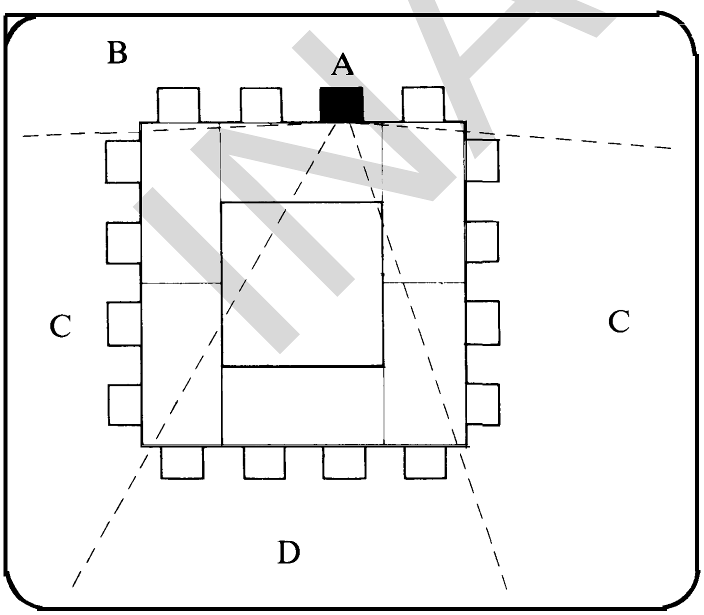
3-4 Design of Audio-Visual Systems

A. Configurations.
U.S. Army Service Schools use A-V equipment in six general configurations shown in Figure 3-10.

B. Storage.
Sufficient space should be programed within the school to allow for the storage and maintenance of A-V equipment and materials. This space is, at a minimum, that necessary to meet day-to-day operational requirements. It can be determined by analyzing specific instructional programs on a school-by-school basis. This space will be located in the technical library, training aids offices, or other area close to classrooms and instructor preparation areas. Paragraph 2-4c.(2)(m) above contains additional information on storage areas. The A-V storage space required can be determined from the following table:

Media	Storage Volume (Units per Cubic Foot)
16mm film (400 ft. reels)	9 reels
Film strip	160 strips
8mm film loops	45 loops
35mm slides	535 slides
Audio cassettes	143 cassettes
7 inch reel audio tape	42 reels
Long playing records	40 records
Overhead project transparencies	64
Microfilm 35mm	34 films
Microfilm 16mm	68 films
Microfiche	1,785 cards

C. Visual Field.
Although the eye can perceive objects over an extremely wide visual field (a horizontal arc of approximately 200 degrees), the major visual field consists of a cone of 30 degrees - 15 degrees on either side of center. It has been estimated that 70% of all vision takes place within this field. To occupy the full 30 degrees visual field, a display must be located at distance from the eye equal to twice the width of the display (2W). Effective viewing, then, requires a minimum viewing distance of 2W. (Figure 3-11). The



A Instructor
B Zone of Minimum Participation
C Zone of Average Participation
D Zone of Maximum Participation

Figure 3-9
Visual Contact/Discussion Participation Relationship

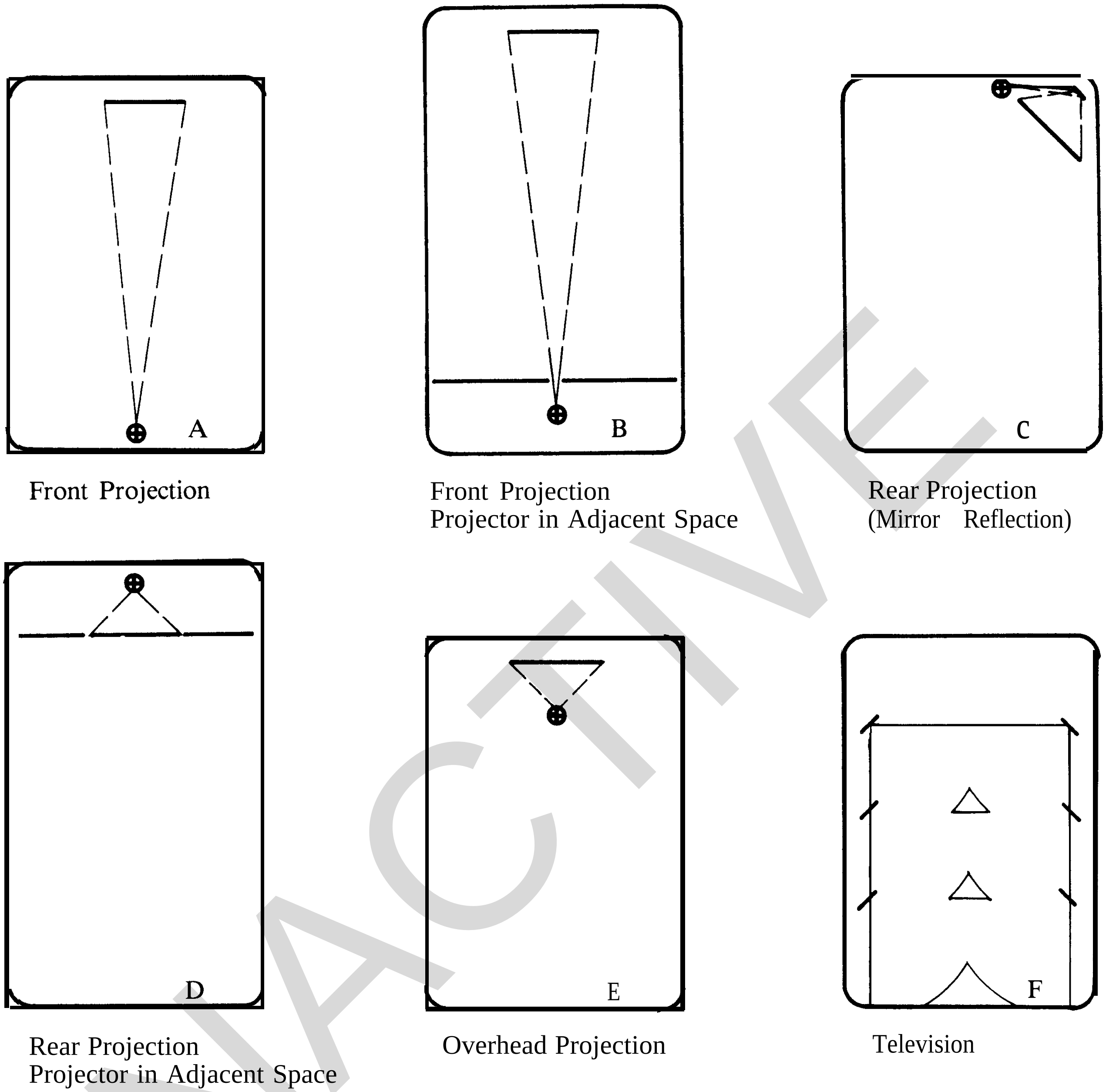
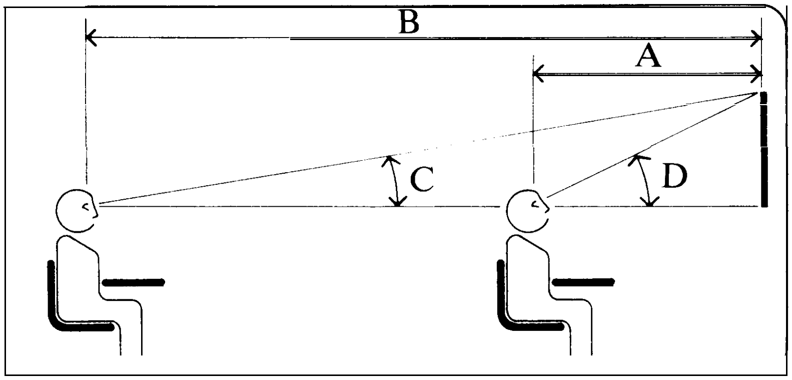


Figure 3-10
Configurations of Audio-Visual Systems

optimum visual field, however, is even smaller. Research has established that this field is approximately 9 degrees, which represents an optimum viewing distance of 6 1/4 W. (Figure 3-11). These data shall be considered in the design of all school activity spaces and are especially important in the design of audio-visual facilities.

D. Audio-Visual Presentation Systems.
There are two general categories of A-V systems: tube screen (used for television, both central broadcasts and videotapes) and reflected screen (used for movies, slides, overhead projectors, and projected television). Reflected screen devices, in turn, fall into two categories: front and rear projection systems. Each of these A-V systems places different requirements on the design of an instruction space. Projected television is the most complex of these systems and has the most demanding requirements for precision installation and



A 2 (width of screen)
B 6.25 (width of screen)
C 9 Degrees
D 30 Degrees

Figure 3-11
Projection Screen Location Related to the Cone of Vision

operation. These characteristics should be carefully investigated prior to programing a projected television system.

(1) Tube Screen Viewing Characteristics: (Figure 3-12).

a. The maximum viewing area extends 45 degrees each side of center, forming a "visual cone" of 90 degrees.

b. The minimum viewing distance (that is, the closest the spectators may sit to the screen) is 5W (five times the width of the screen). The preferred minimum viewing distance, however, is 8W.

c. The maximum viewing distance is 14W; the preferred maximum is 10W.

d. The bottom of the screen must be 48 inches from the floor to permit unobstructed viewing by all spectators.

e. "W" for tube screen is practically limited to a 25-inch screen unit (actual visual "W" approximately 22 inches). However, tube screen equipment is improving, and larger, more economical screens may be developed. The availability of such screens must be investigated when audio-visual systems are programed.

(2) Reflected Screen Viewing Characteristics: (Figure 3-13).

a. The maximum viewing area extends 50 degrees either side of the screen. The preferred area, however, extends 40 degrees.

b. The minimum viewing distance from the screen is 2W, but 4W is the preferred minimum.

c. The maximum viewing distance is 8W, 6W the preferred.

d. The bottom of the screen must be 48 inches from the floor; the top may extend to within 6 inches of the ceiling.

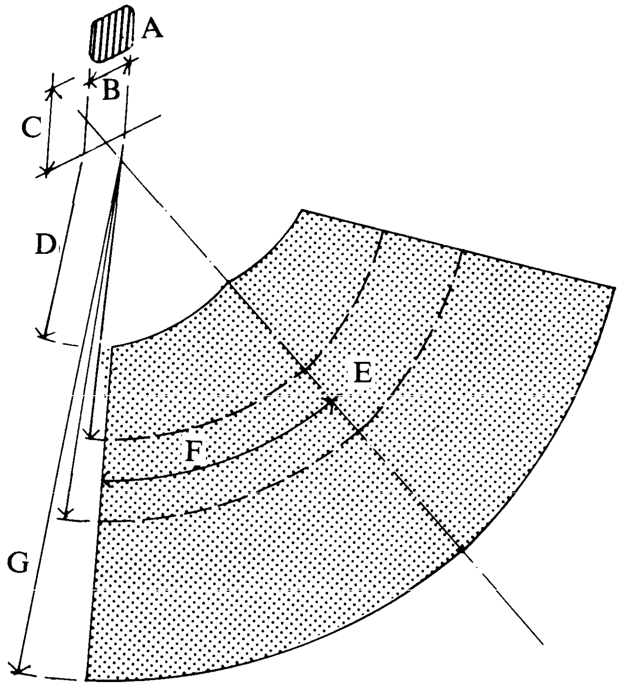
e. Reflected screens are not limited in size.

(3) Comparison of Front and Rear Projection Systems. With a front projection system, images are projected onto an opaque screen from a location in front of the screen. Rear projection systems project an image onto a translucent screen from a position behind the screen. The following is a comparison of the two systems in terms of their spatial impact on classroom design:

a. Shadows on Image.
Rear projection systems permit lecturing and demonstrating concurrent with medial projection, with no obstruction of the image by shadows. With front projection systems this is more difficult to accomplish.

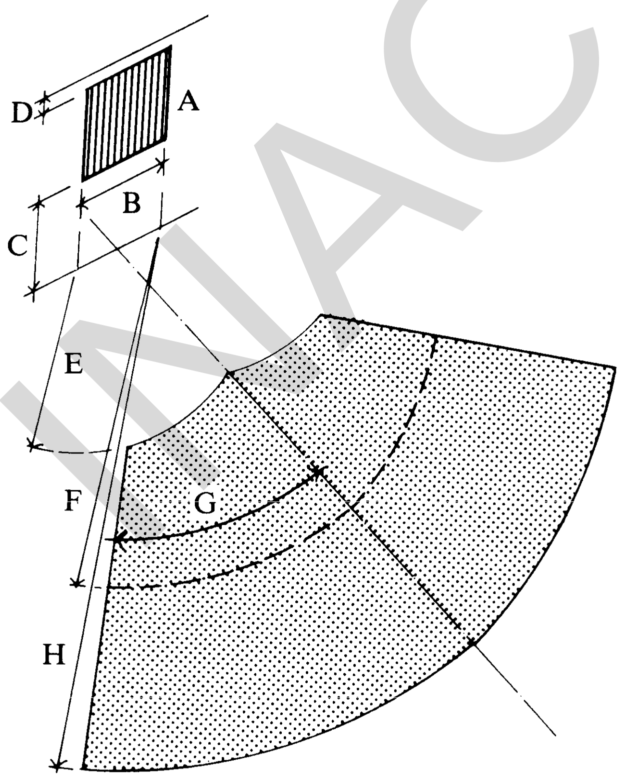
b. Location of Projector.
Front projection equipment is located at the end of the room opposite the lecturer. This necessitates either remote operation, an attendant, or automatic delivery. Rear projection equipment located in a separate projection room presents the same problem. However, it may also be located beside the lecturer, with the image being projected onto the rear of the screen by a series of mirrors. This system permits manual control of the projector by the lecturer, and facilitates the handling of projector malfunctions.

c. Audience Size.
Given equally sized screens of equal brightness, a front projection system permits more persons to be seated within the favorable viewing area because the projector is farther from the screen. As Figure 3-14 shows, theoretically it would be possible to locate a rear projector at a distance from the screen of 6W, thereby



A Tube Screen
B Screen Width (W)
C Screen Height Above Floor (4")
D Closest Viewing Point,
58W (minimum)
E Preferred Viewing Range, 8W-10W
F Maximum Viewing Angle
From Centerline (45°,)
G Farthest Viewing Point,
14W (maximum)

Figure 3-12
Television Tube Screen Viewing Criteria



A Reflected Screen
B Screen Width (W)
C Screen Height Above Floor (48")
D Screen Clearance From Overhead
(6" minimum)
E Closest Viewing Point,
2W (minimum)
F Preferred Viewing Point, 6W
G Maximum Viewing Angle
H Farthest Viewing Point,
8W (maximum)

Figure 3-13
Reflected Screen Viewing Criteria

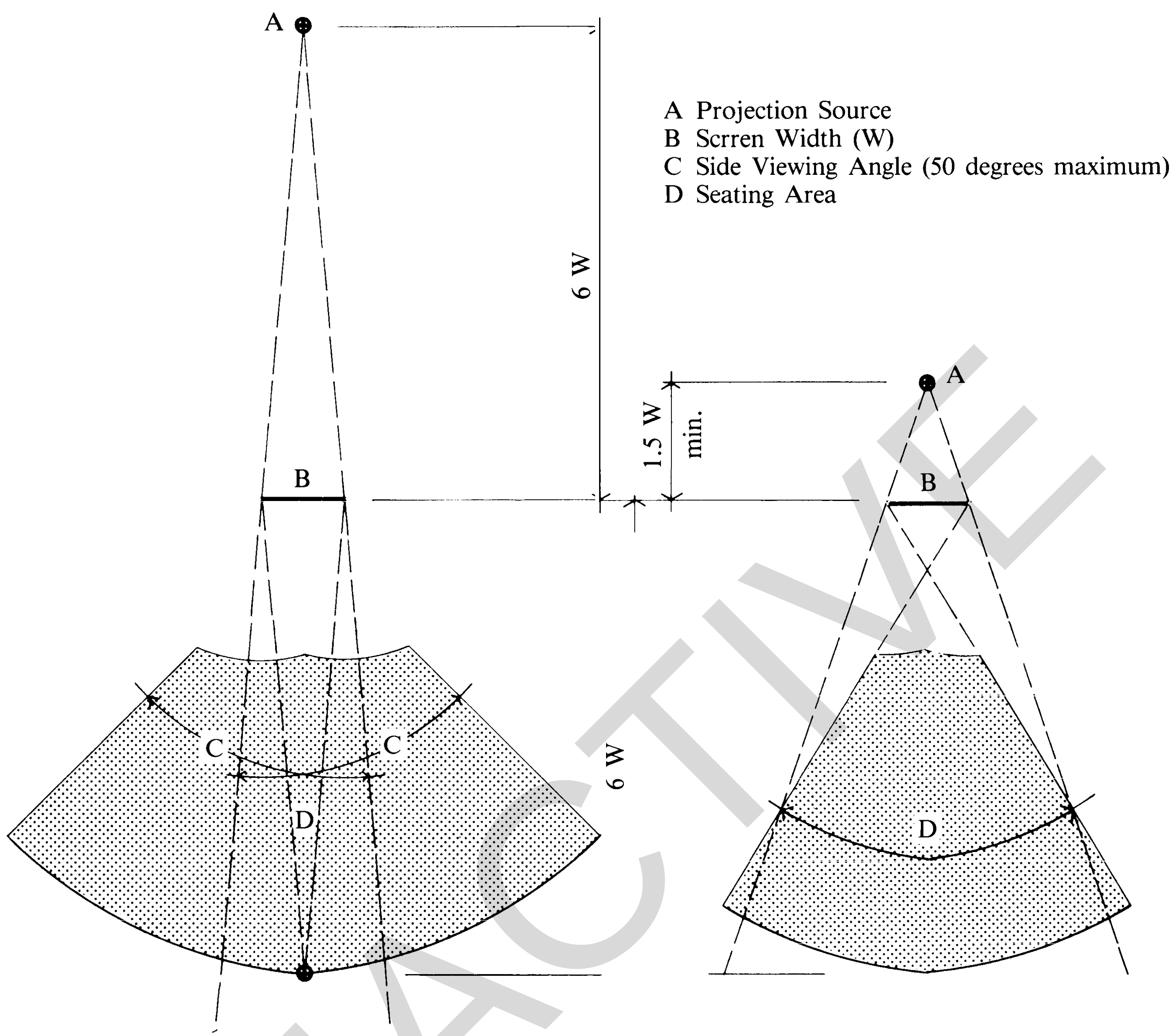


Figure 3-14
Comparison of Seating Areas,
Front and Rear Screen Systems

achieving the same seating space as with a front projector. However, in practice this is not feasible, as it would result in grossly inefficient space utilization. As the diagram indicates, with the typical distance of 1.5W between rear projector and screen, the seating area would be approximately two-thirds that of a front projection system.

d. Space Utilization.
Front projection systems utilizing projection rooms require less space than similar rear projection systems, due to the required distance between screen and rear projector of 1.5W. (Figure 3-15). However, rear projection systems which locate the equipment in the classroom rather than in a separate projection room and use mirrors to achieve the necessary distance to the screen, require no more space than do front projection systems. (Figure 3-16).

e. Flexibility.
Rear projection screens located in separate rooms limit the flexibility of the building by interposing dedicated space between non-dedicated classroom spaces.

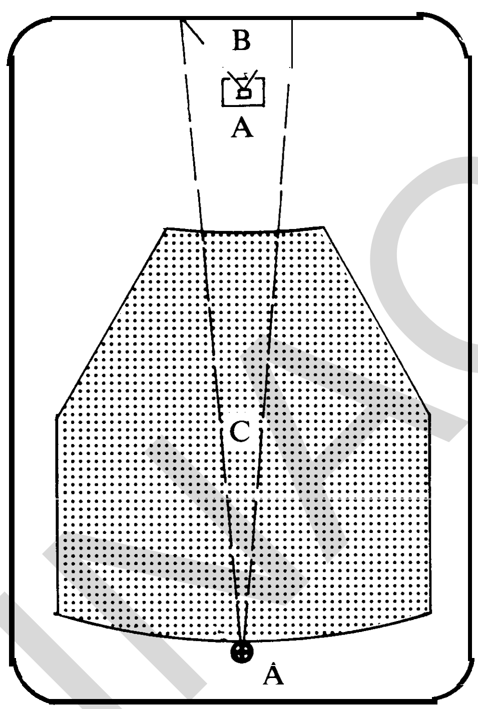
f. Image Quality.
Front projection systems afford better image quality over a broader seating area than do rear projection systems. (Figure 3-17).

g. Economy.
Rear projection systems are considerably more costly than front projection systems, initially and over the life of the facility. Separate rear projection rooms provided indiscriminately to all classrooms could raise the required area for a school (and the total cost) as much as 25%. In addition rear projection systems are essentially static and complete equipment would have to be provided in each classroom with a projection requirement. Front projection systems are highly portable and can be furnished on a check-out basis as needed; therefore fewer pieces of equipment need to be procured. The screens and projectors for rear projection equipment are generally more costly than those for front projection.

h. Conclusions.
Front projection systems are more economical and permit more efficient utilization of space and equipment: the seating area is larger, the image quality is better over a greater area, fewer pieces of equipment are required to serve the needs of the school, and less space is required for the projection. Rear projection systems are preferable from the lecturer's point of view; the projecting equipment can be nearby, (either in an adjacent enclosed space behind the lecturer or next to the lecturn, with the image projected by mirrors), giving the instructor manual control, and there is no shadow interruption of the image. In view of the above, requirements for rear projection systems should be carefully reviewed by each school and fully justified in Project Development Brochures.

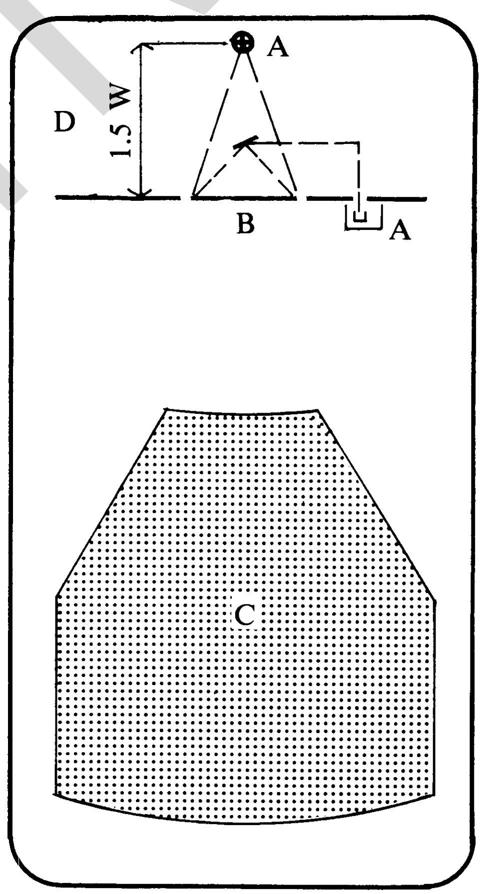
E. Viewer Sightlines.
In determining the design of a space to be used for A-V presentations, viewer sightlines are the most important consideration. There are several factors contributing to viewing ease:

(1) Sloped Floor.
Audiences of more than fifty people generally require



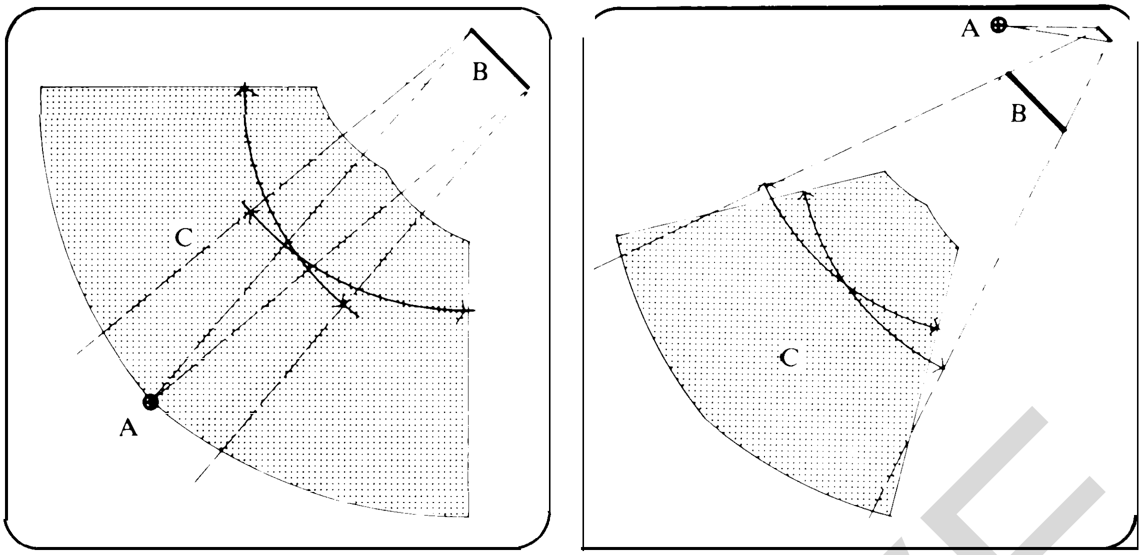
Front Projection

A Projection Source
B Screen Width (W)
C Seating Area
D Projection Room (dedicated space)



Rear Projection

Figure 3-15
Comparison of Total Space,
Front and Rear Screen Systems



Front Projection

Rear Projection

A Projection Source
B Screen
C Seating Area

Figure 3-16
Comparison of Space Utilization
Front and Rear Screen Systems

sloped floors. In rooms designed for television viewing, an alternative is to install the television sets along perimeter walls.

(2) Square Room.
A room of approximately square shape is best for A-V presentations; excessive width or length will cause visua1 and acoustic distortions.

(3) Image Distortion.
As the distance of the viewer from the room's center increases, so does the image distortion. Figure 3-18 indicates the amount of distortion occurring at various viewing angles.

(4) Relationship Between Viewing Area, Screen Height, and Ceiling Height.
Generally, the screen height is determined by the room's ceiling height. The screen must be at least 4 feet above the floor and typically 6 inches from the ceiling. A screen width is then selected so that the screen's proportions are compatible with the proportions of commonly projected images. The screen width, together with the nature and location of the projection source, establishes the recommended viewing area. The ceiling should be high enough to insure necessary image sizes on the project screen, provide all students a good view of the screen, and prevent students' heads from casting shadows on the screen when using rear projection. Ceilings higher than 12 feet are seldom required, but should not be less than 9 feet high. If a projection screen is used, the required ceiling height, C (feet), can be found using the equations below and assuming that the bottom of the screen will be placed 4 feet above the floor and that the distance between the top of the screen and the ceiling will be 6 inches. For horizontal image formats, where the image height is less than or equal to the screen width, W (feet) is divided by 1.33:

$$C = 4.5 + \frac{W}{1.33}$$

where the room length, L (feet), is 6W. This can be simplified to establish a direct relationship between L and C:

$$L = 8C - 36$$

For vertical image formats, where the image height is greater than or equal to the image width:

$$C = 4.5 + W$$

and

$$L = 6C - 27$$

If vertical formats (slides) will also be used, the screen height value H is equal to W, and will require additional height.

(5) Full and Partial Viewing Sectors.
For a given screen size, using the maximum viewing area permits a greater number of seats than does a partial viewing sector; however, it results in less efficient utilization of space, as only 30% of the room can be occupied by seats. By using a more rectangular room, seating area is decreased by one-third, but room space is utilized more efficiently: seats may occupy 40% of the room. (Figure 3-19). Furthermore, the seating eliminated by this arrangement is that portion of the seating located along the least desirable viewing angles.

F. Lighting Design for A-V Presentation.

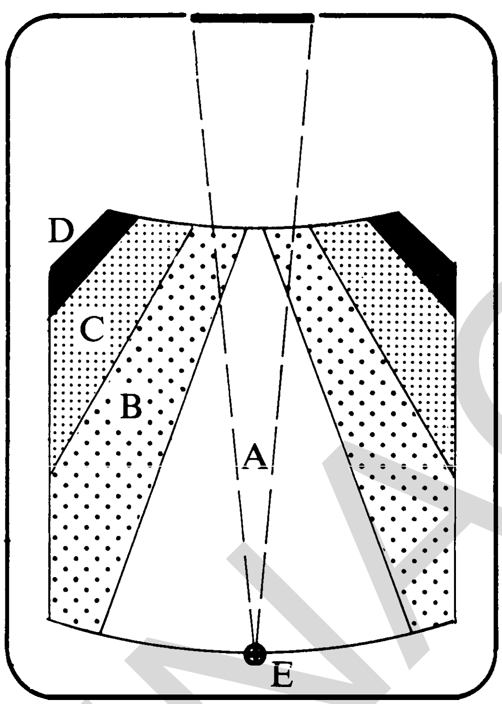
(1) Controls.
Room lighting must be controlled for different media and viewer tasks. The controls must be conveniently located near the screen, easy to operate, and allow complete control by a single person.

(2) Lighting Levels.
Room ambient light level should be between 10% and 33% of the screen (or tube) brightness. Recommended ambient light levels for particular media and output sources are:

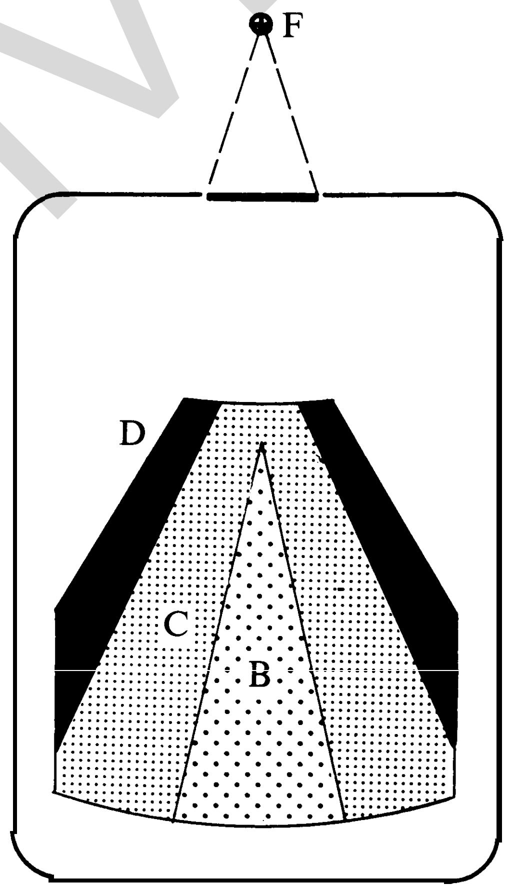
Media	Source	
	Normal	High-Output
16mm film	5-10 fc	15-25 fc
35mm slides	15-25 fc	25-35 fc
	Videotape	Projected
Television	35 fc	4-10 fc

G. Ventilation.

Criteria and design of mechanical systems for A-V rooms shall be identical to the classrooms served.



Front Projection



Rear Projection

A Excellent
B Very Good
C Good
D Fair
E Front Projection Source
F Rear Projection Source

Figure 3-17
Comparison of Image Quality,
Front and Rear Screen Systems.

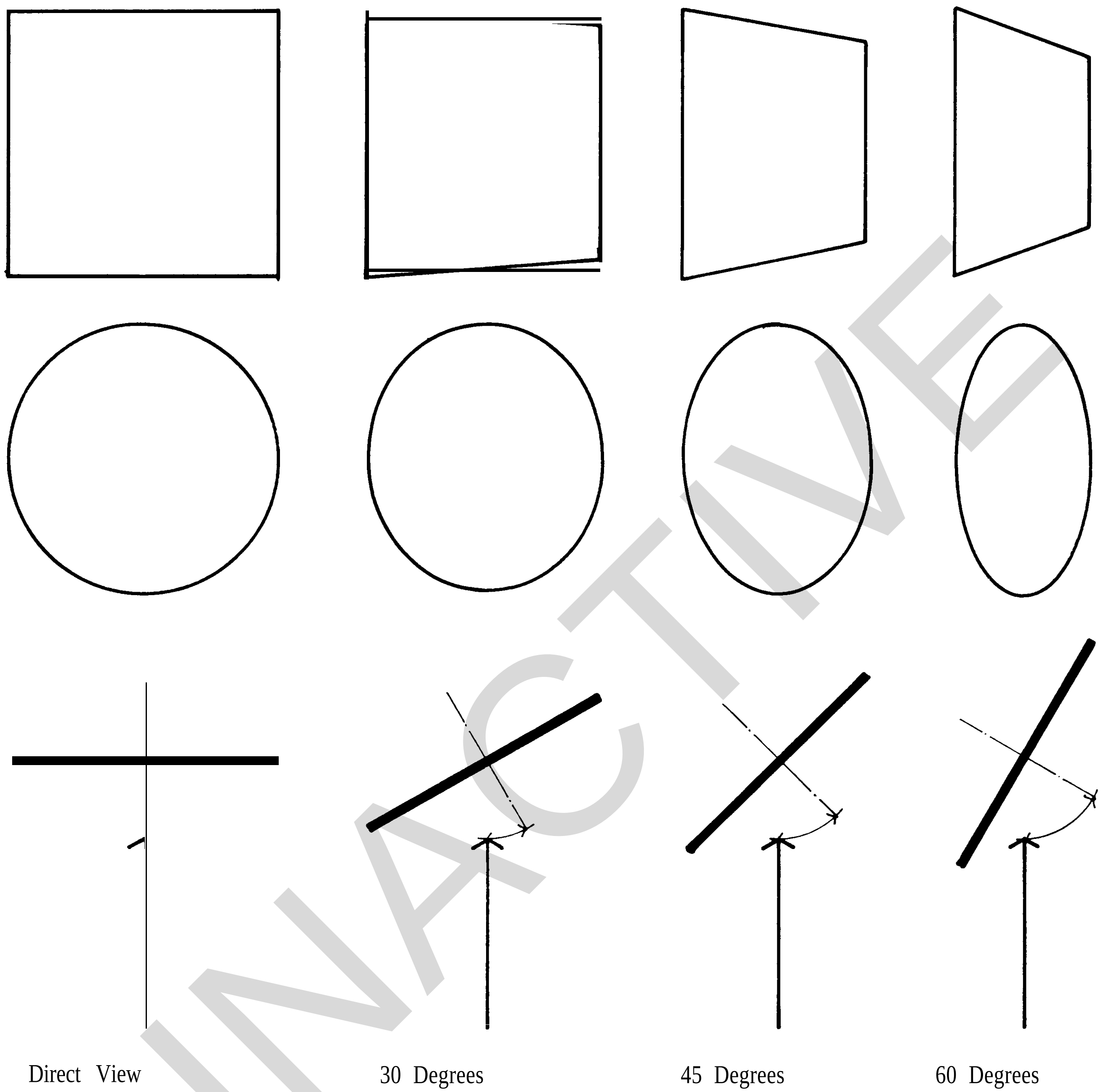
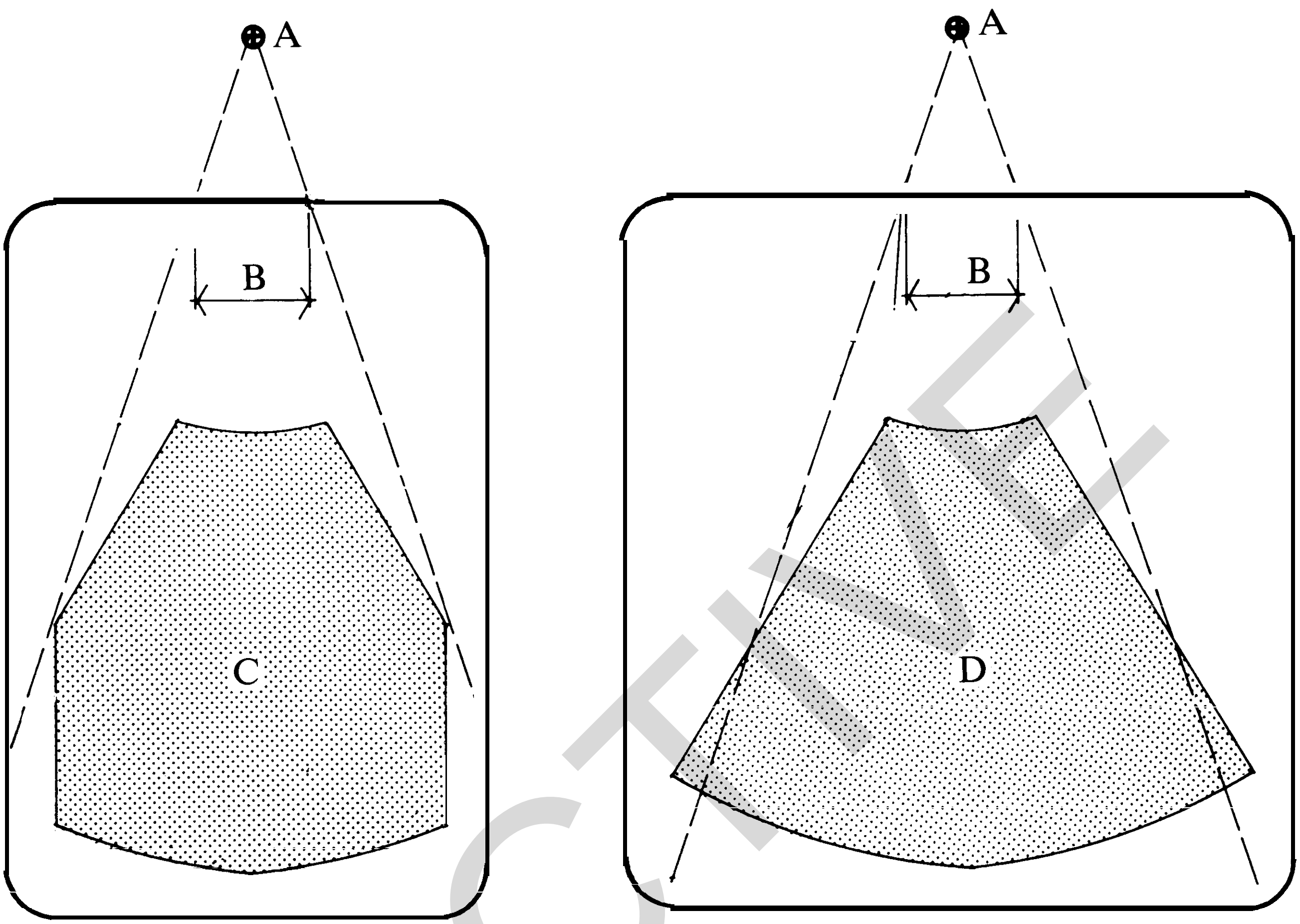


Figure 3-18
Image Distortion.



A Projection Source
B Screen Width (W)
C Seating Area Partial Viewing Sector
(40% room area)
D Seating Area Full Viewing Sector
(30% room area)

Figure 3-19
Seating in Partial Viewing Sector

4-1 General.

The information in this chapter can help the planner/designer identify and resolve both the needs of new Army service school buildings and the problems of existing ones. It gives Army service school facility users a reference for judging space needs and evaluating space quality. The purpose of this information is not to give patent answers, but to help Army service school users understand local space needs and encourage the planner/designer to produce a creative, successful solution responsive to local needs. Army service schools are divided into four major space types: training, training support, office and shared spaces. Each of these is subdivided into specific kinds of spaces. (Figure 4-l). This chapter presents design

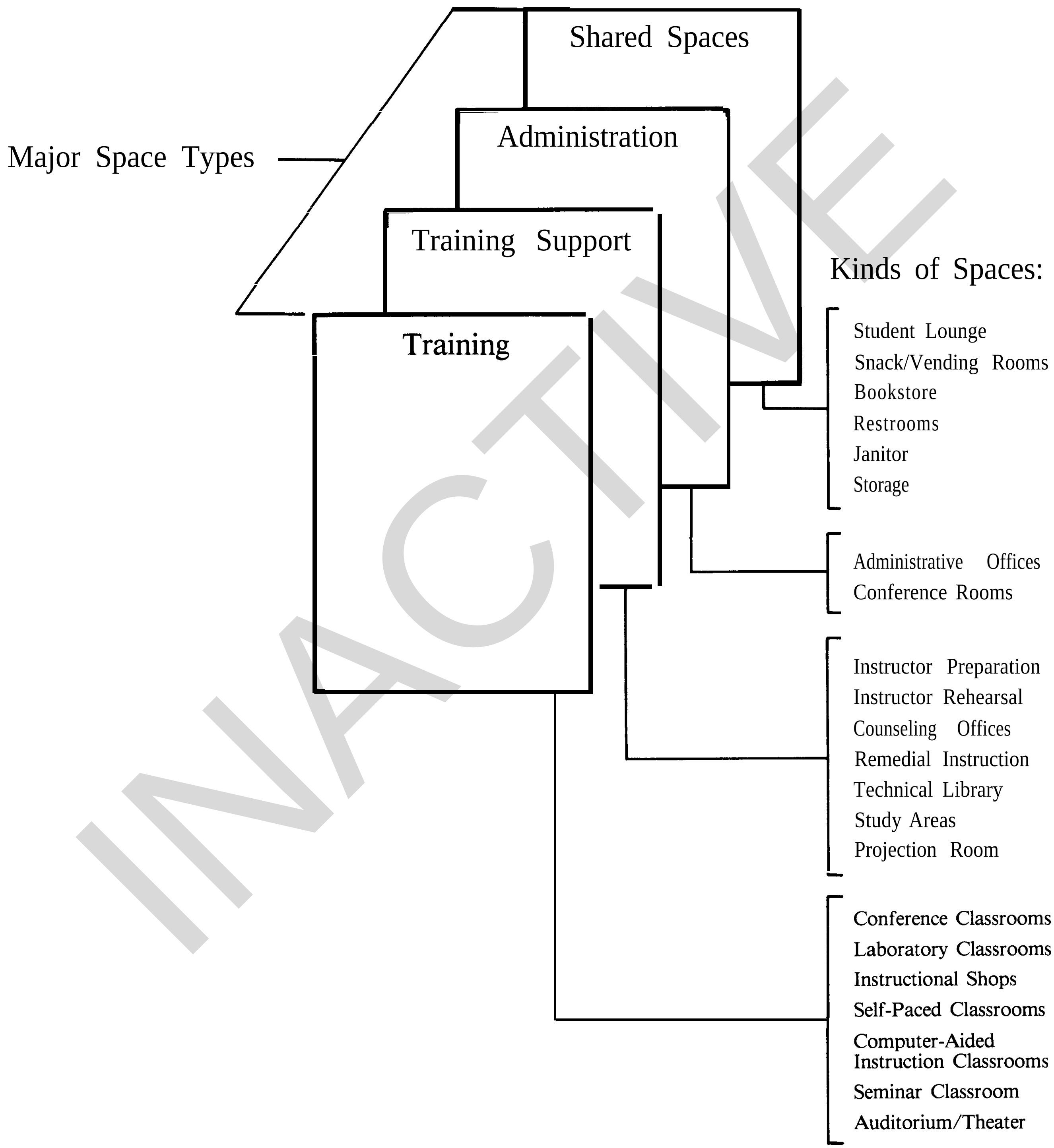


Figure 4-1
Types of Design Requirements.

information in the form of requirements and criteria for all space types. REQUIREMENTS either help define problems or explain what requirements. Information about each space type is presented in two formats. First, design requirements and criteria are presented in the form of assumptions and planning/design data. (Figure 4-2). Local users should verify the assumptions for use by the planner/designer. If necessary, the assumptions should be modified to reflect actual usage and activities, occupants, equipment and supplies, and schedules of the local situation. Second, at the end of each section, requirements and criteria for that space type are summarized in a table.

4-2 Conference Classrooms.

A. Use/Activities.
One or more instructors typically use classrooms to conduct lectures, presentations, or demonstrations, using a variety of training aids. The primary activities of the students are seeing, hearing, and writing. Requirements and criteria for effective communication and the ability of the instructor to establish a relationship with students vary with group size, teaching methods, and media used.

B. Occupants.
The number of instructors, including teaching aides or technicians, may vary from one to 10. The audience could be as large as 200.

C. Equipment/Supplies.
The instructor may need a platform, chalkboards, tackboards, map hangers, projection screens, and equipment for demonstrations at the front of the room. A lectern, table, or desk may also be needed. Desks may have to be arranged in temporary or permanent tiers so that students can see the instructor and/or training aids. These desks should have a writing surface. Tables and chairs may also be used. Projection or sound equipment that is kept permanently in the classroom should be placed on movable stands or mounted securely. Other demonstration/training aid equipment can be stored next to the classroom.

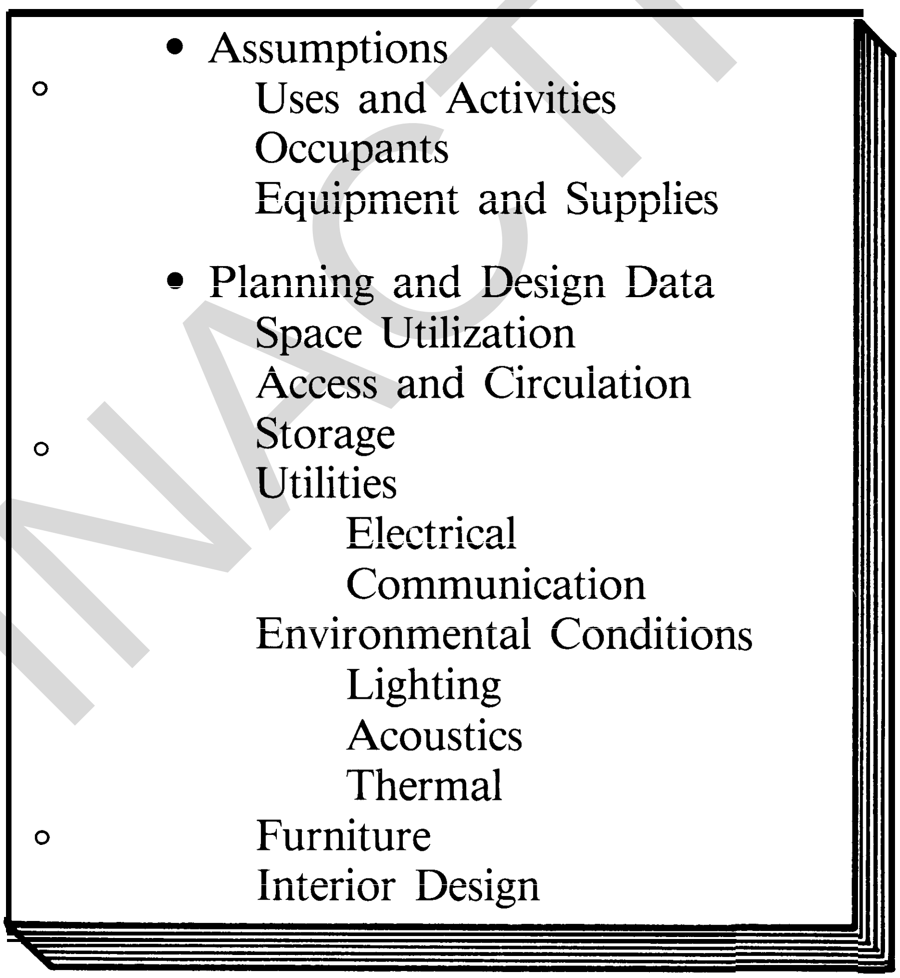


Figure 4-2
Types of Design Requirements

D. Space Utilization.
Classroom space should be sized to support a variety of classes, instruction methods, and classroom activities. A lower limit of 25 square feet applies to classrooms which just require chairs that do not have note-taking arms. An upper limit of 35 square feet applies when there is a continuous need for audio-visual (A-V) presentations, writing surfaces, and the use of reference materials.

E. Access/Circulation.

(1) Location.
A classroom should be conveniently located and away from noisy areas. The classroom should be separated from spaces that require privacy, but near other training spaces. It is best to centrally locate a frequently used classroom (Figure 4-3 and paragraph 5-2 below).

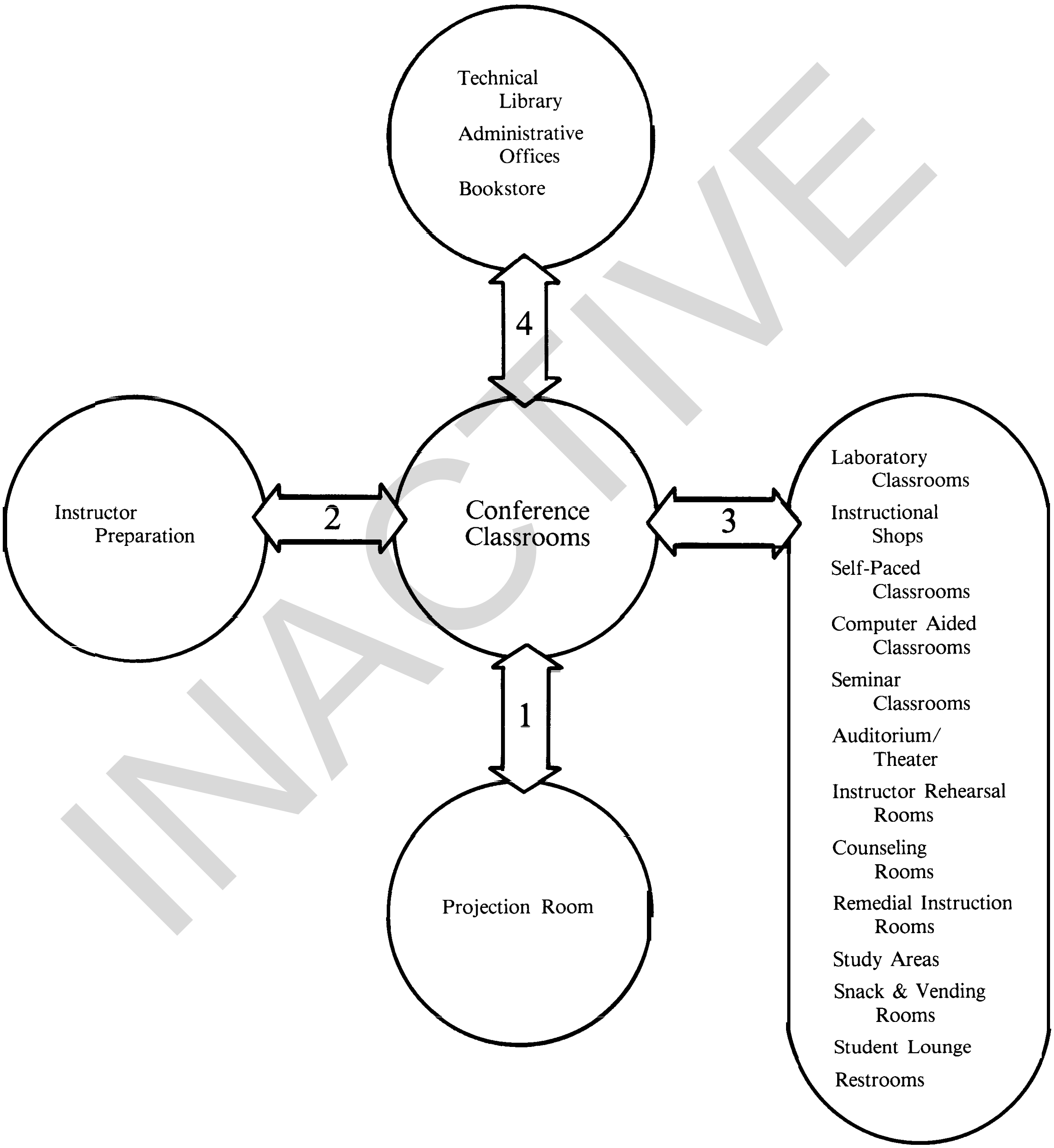


Figure 4-3
Spaces Near Conference Classrooms.

(2) Circulation Within Room.
Furniture and training aids should be arranged to provide good visual contact between the instructor and students, to allow students to see images on projection screens easily, and to permit safe exiting in emergencies. Windows should be located along the sides so that neither students nor instructors have to look into the glare of window-light. Seats for students should not be closer than 2W nor farther than 6W from a projection or television screen of width W. Refer to paragraph 3-4 above. Aisle widths and locations and the number of seats which can be placed together between aisles must comply with life safety standards.

(3) Room Openings and Access.

a. Late students should be able to enter classrooms without disrupting class activity. At least one door should be at the rear of the classroom.

b. Access to classroom conducting classified instruction should be controlled. See guidance on physical security in FM 19-30.

c. Circulation around and into classrooms should be easy and provide for safe exiting in emergencies. All doors should be at least 3 feet wide and recessed so as not to stick out into the corridor when opened. Doors must swing out from the room. Two exit routes should be provided from each classroom; more may be needed for very large classrooms to meet life safety standards.

(4) Movement.
Movement of equipment in and out of classrooms should be easy. Classroom doorways should not have thresholds. Where large furniture or equipment is used, double doors should be provided or the doors sized to allow easy movement of equipment.

F. Effect of Audio-Visual (A-V) Systems on Seating Arrangements.

(1) Considerations.
Seating arrangements should be planned to support A-V aids for object demonstrations. Student viewing should be the primary concern in developing instructional spaces. Conference rooms for fewer than 50 students, intended for lectures which stress screen projection A-V, will not need sloped floors or risers for seating. Conference rooms for object demonstrations of techniques and equipment or for dialogue between students and instructor will need either a permanent or portable riser system. The number of seating rows, the lecture platform height, and the lowest height of demonstration (focal point of viewing) determine the respective heights of the riser elements. Refer to paragraph 3-4 above.

(2) Sample Arrangements.

a. The seating arrangement in Figure 4-5 is typical for conferences, lectures, and A-V presentations on a screen at the front wall.

b. The seating arrangement in Figures 4-4 and 4-6 is for equipment demonstrations and television viewing. In Figure 4-6, viewer-to-object distance for demonstrations is shorter than given in Figure 4-4; however, A-V screen presentation is not satisfactory because the viewing angle is too oblique for students seated at the side. Television viewing from the two positions shown lets all students see well.

Dimension: 25 feet by 30 feet.

Ceiling Height: 10 feet.

Seating: 24 individual stations with table 2 feet by 3 feet or 12 shared stations with table 2 feet by 5 feet.

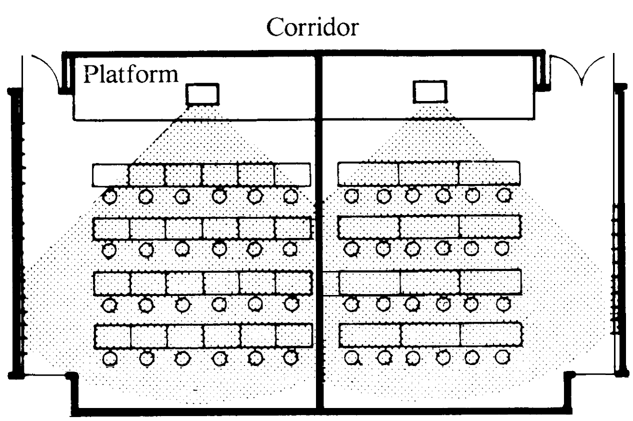


Figure 4-4
24-Student Classroom.

Dimension:	30 feet by 50 feet.
Ceiling Height:	10 feet (maximum riser height 2 feet).
Seating:	50 individual stations with table, 2 feet by 3 feet.

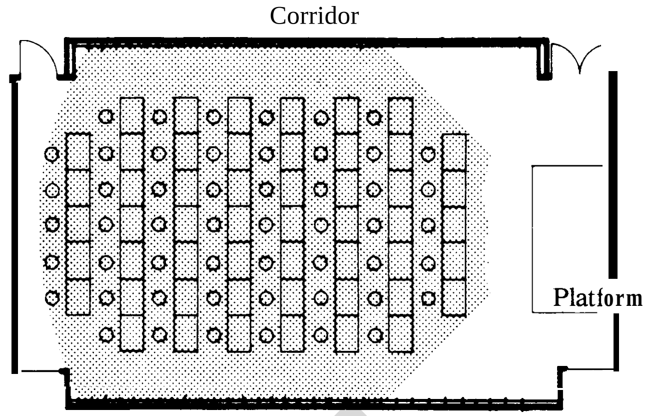


Figure 4-5
50-Student Classroom Using Projection Methods of Presentation.

Dimension:	30 feet by 50 feet.
Ceiling Height:	10 feet (maximum riser height 2 feet).
Seating:	50 individual stations with table, 2 feet by 3 feet.

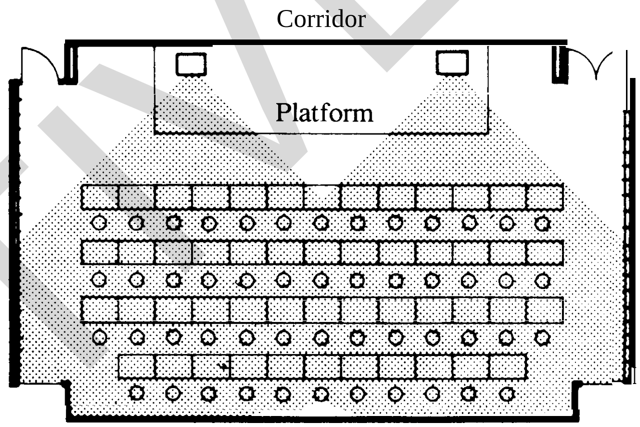
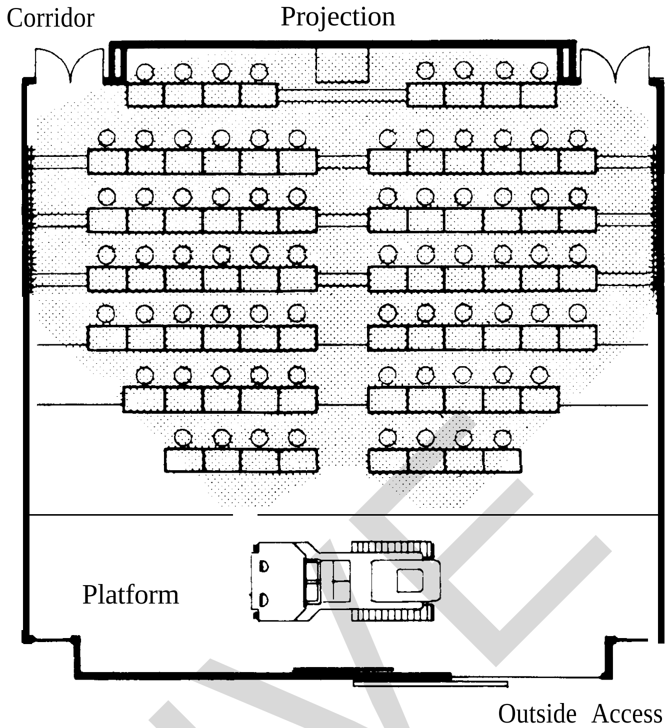


Figure 4-6
50-Student Classroom Using Television Presentation Methods.

c. In Figure 4-7, the arrangement is for platform lecture, screen projection, television A-V presentation, and equipment demonstration. Entrance to the room from the corridor is near the midpoint of the risers; movement is up or down to the seating area and to the platform for equipment demonstration and lecture. The 50-foot room width is consistent with modular school construction. The depressed floor allows integration of this space with adjacent grade-level areas having 10-foot ceilings. Site area adjacent to the exterior wall should be contoured to allow equipment to enter platform areas below grade level.



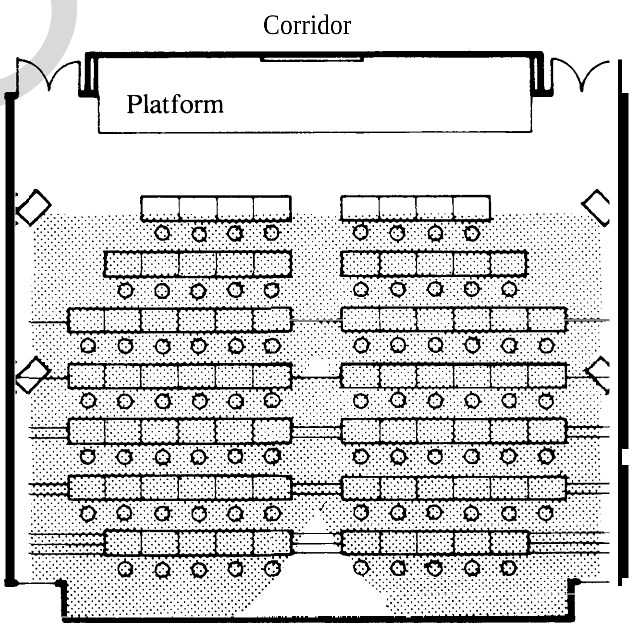
Dimension: 50 feet by 55 feet.

Ceiling Height: 10 feet above top entrance level (maximum riser height 2 feet above entrance level).

Seating: 75 individual stations with table, 2 feet by 3 feet. 6 riser levels.

Figure 4-7
75-Student Classroom Using Projection Methods of Presentation.

d. The arrangement in Figure 4-8 is for platform lecture, screen projection, and television presentation.



Dimension: 50 feet by 45 feet.

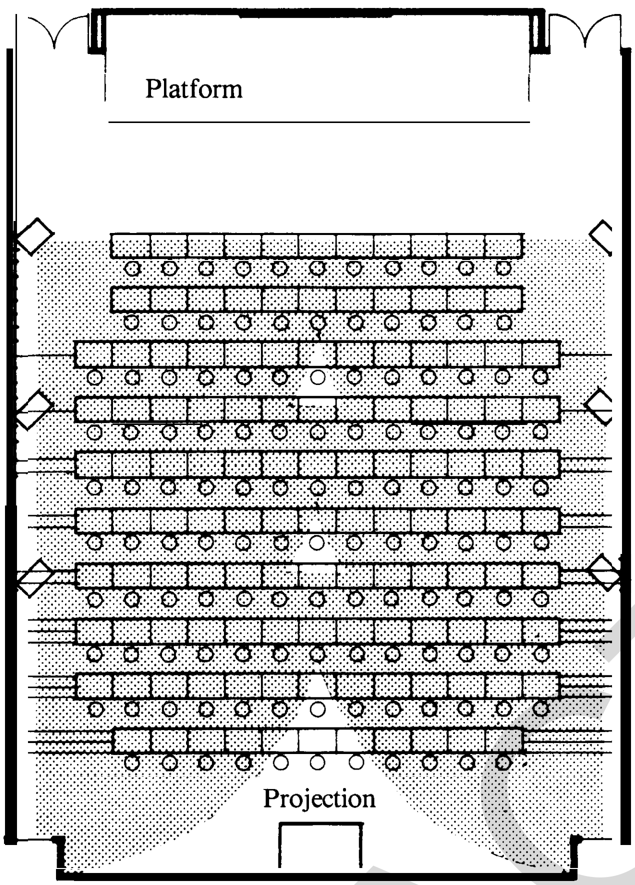
Ceiling Height: 8 feet above top seating level (seating level determined by minimum focal point elevation for viewing).

Seating: 75 individual stations with table, 2 feet by 3 feet. 5 riser levels.

Figure 4-8
75-Student Classroom Using Television Presentation Methods.

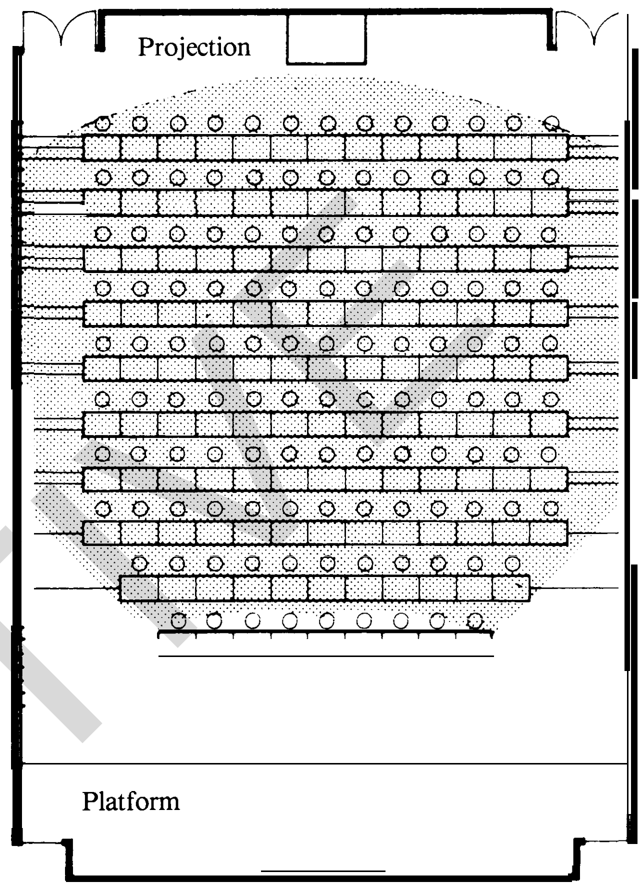
e. The arrangement in Figure 4-9 is for platform lecture, screen projection, and television A-V presentation. There is no exterior access directly into the room. Riser levels are all above the entrance level.

f. In Figure 4-10, the arrangement is similar to that of Figure 4-8; however, the floor is depressed from the entrance level. This allows integration of this large space with grade-level areas next to areas with 10-foot ceilings.



Dimension:	50 feet by 70 feet.
Ceiling Height:	8 feet above top seating level (seating level determined by minimum focal point elevation for viewing)
Seating:	125 individual stations with table, 2 feet by 3 feet. 8 riser levels.

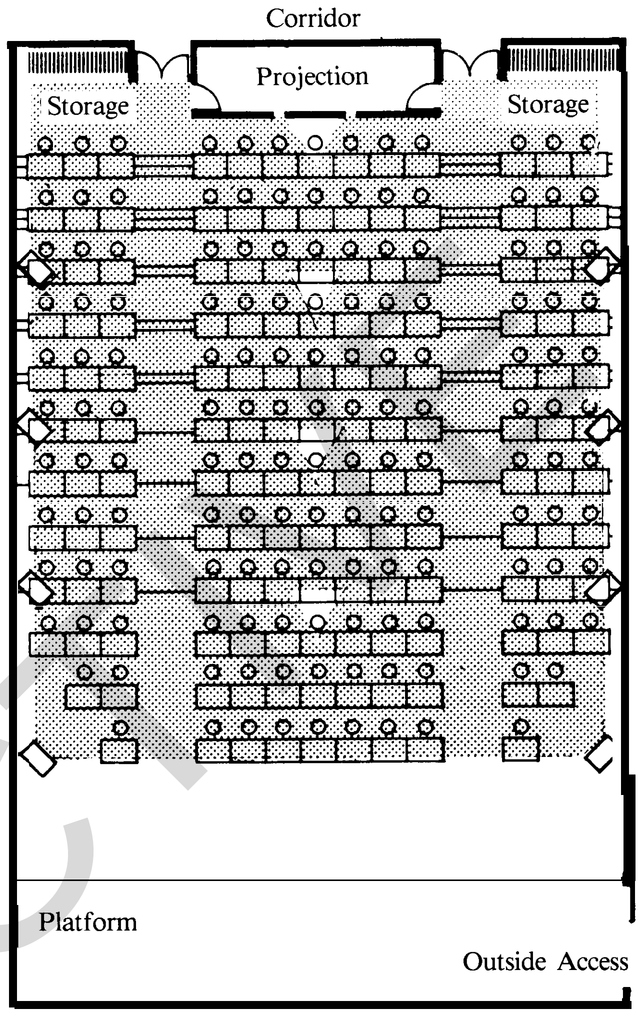
Figure 4-9
125-Student Classroom Using Television Presentation Methods.



Dimension:	50 feet by 70 feet.
Ceiling Height:	8 feet above top seating level (minimum).
Seating:	125 individual stations with table, 2 feet by 3 feet. 8 riser levels.

Figure 4-10
125-Student Classroom Using Projection Methods of Presentation.

g. In Figure 4-11, the arrangement is for platform lecture, screen projection, television A-V presentation, and equipment demonstration with direct exterior access. Consider planning the room with the student entrance from a second-floor corridor and grading the exterior to provide an entrance for demonstration equipment at grade.



Dimension:	50 feet by 80 feet.
Ceiling Height:	8 feet above top seating level (minimum).
Seating:	150 individual stations with table, 2 feet by 3 feet. 9 riser levels.

Figure 4-11
150-Student Classroom.

h. The arrangement in Figure 4-12 is for platform lecture, screen projection, television A-V presentation, and equipment demonstration with direct exterior access. Consider planning the room with a second-floor student entrance and grading the exterior level up to the platform access point or with a first-level student entrance and grading the exterior level down to the platform access point. A space of this scale, requiring a 65-foot structural span, should be built as a single-story element.

Dimension:
65 feet by 90 feet.

Ceiling Height:
8 feet above top seating level (minimum).

Seating:
200 individual stations with table, 2 feet by 3 feet. 10 riser levels.

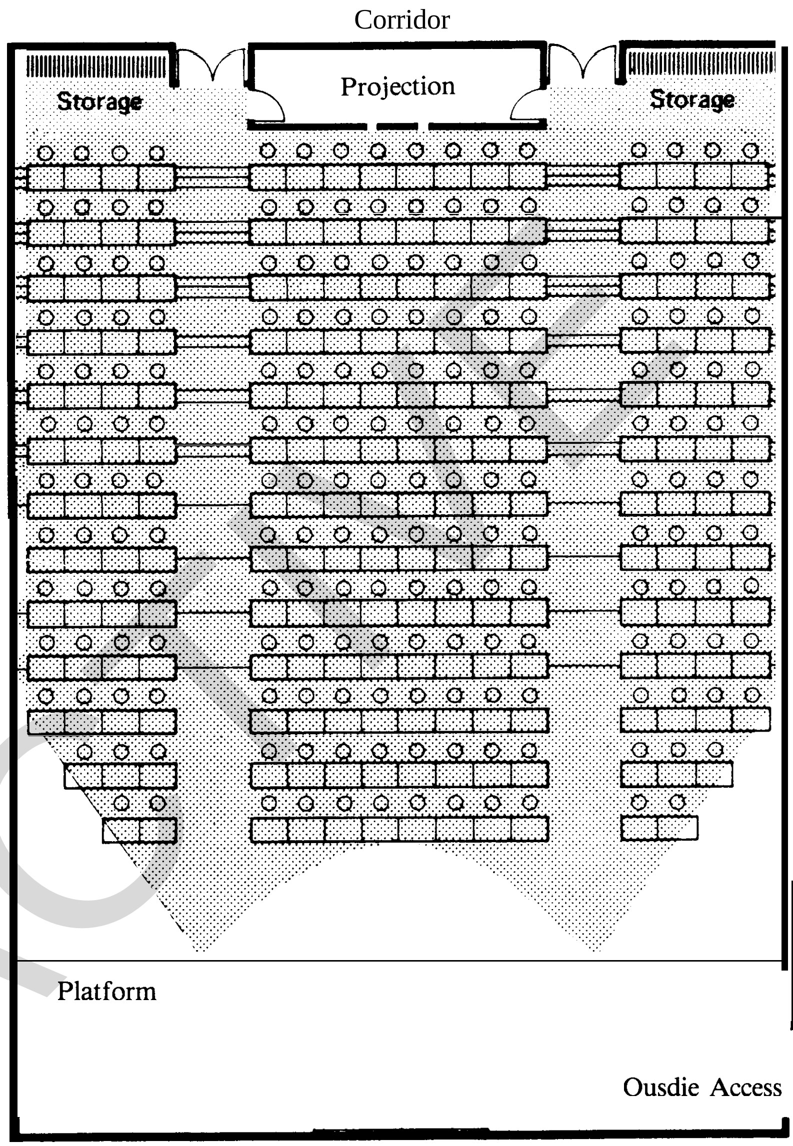


Figure 4-12
200-Student Classroom.

i. The arrangement in Figure 4-13 is for platform lecture, screen projection (portable screen) and television A-V presentation, and more specifically, large equipment demonstrations to one or both class areas. Student and equipment access is from grade level. Riser levels are all above entrance level.

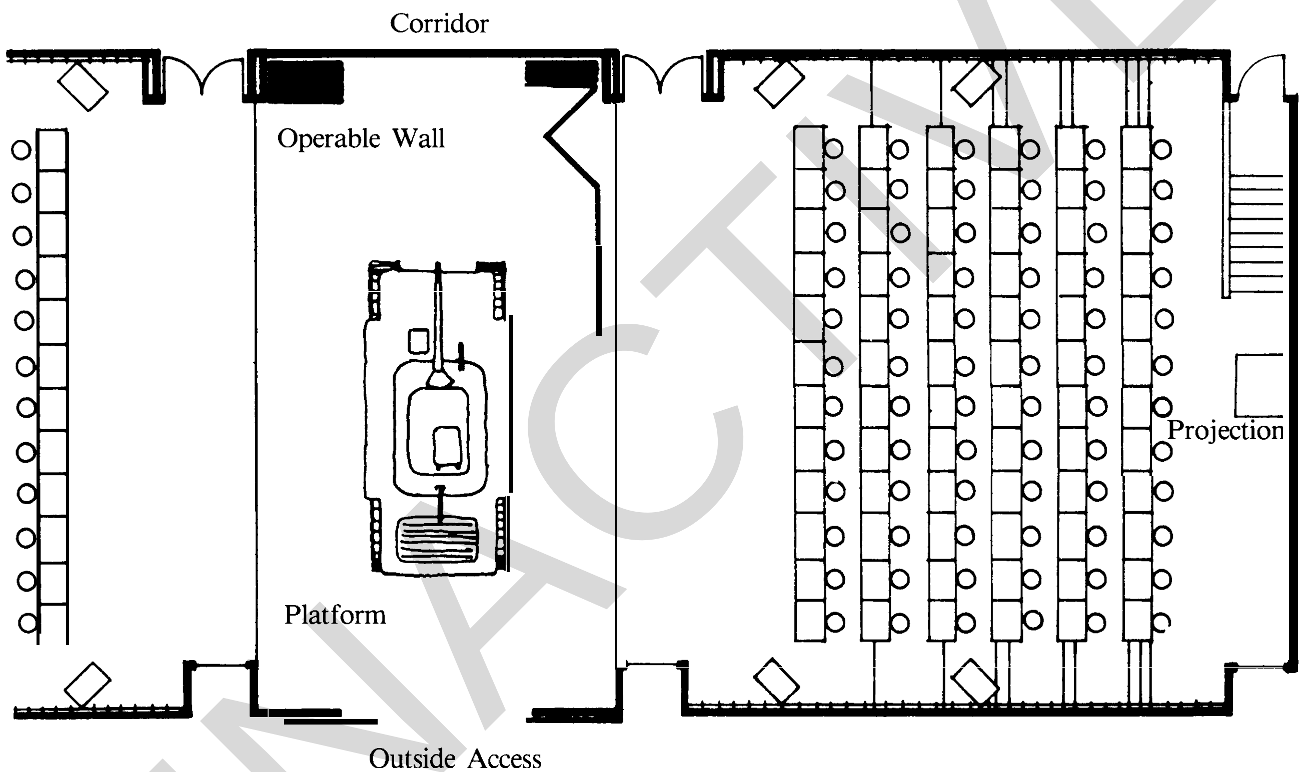
G. Electrical and Controls.

(1) There should be enough wiring to support all equipment used in classroom presentations or demonstrations, or for anticipated future use. Power and communication and electronic cables should be enclosed to minimize the need to string cables across the floor. Sufficient receptacles and jacks should be provided at convenient places in each classroom.

(2) Controls for lighting, A-V equipment, and sound systems should be located where the instructor can easily reach them. The preferred location for controls is at the front of the room where the instructor stands. In classrooms where a lectern is almost always used, a control panel built into the lectern may be desirable. Lighting controls provided for the instructor's convenience may be redundant to controls normally located near exits. However, dimming controls need only be included for the instructor.

H. Lighting.

(1) Daylight entering the room through windows must be controlled to minimize shadows, glare, and heat gain. During the day, artificial light should be used to



Dimension:	50 feet by 150 feet (two rooms, one equipment stage).
Ceiling Height:	8 feet above top seating level (seating level determined by minimum focal point elevation for viewing) and safe clearance for largest object for demonstration.
Seating:	70 individual stations with table, 2 feet by 3 feet. 5 riser levels.

Figure 4-13
70-Student Classroom.

supplement daylight. Daylight should be reflected into the room by overhands and light shelves; it should never be direct. Artificial (electric) light should be used to balance the level of daylight across the room depth. This requires controlling electric lights to respond to different levels of daylight illumination.

(2) Classroom lighting controls should be convenient to the instructor. General classroom artificial lighting should be zoned into levels of illumination to supplement daylighting. Incandescent task lights should be circuited for infinite light intensities of zero to full lamp wattage. Blinds or other daylight-omitting devices should be provided for use of A-V equipment. Lighting controls should be placed at the front of the room with A-V controls.

(3) Only occupied areas of a classroom need to be lighted. Light switches should control classroom zones. It is better to establish zones that extend across the room than the length of the room.

(4) There should be sufficient task lighting. Adjustable track or eyeball (spot/flood) lighting should be used to illuminate the instructor, classroom demonstrations, chalkboards, and other training aids.

I. Subdivided Classrooms.
The 24- and 50-student classrooms are developed within the typical module (paragraph 3-2b above) using a 30-foot-long structural span from corridor to exterior wall line. (Figures 4-4 and 4-5). Classrooms that hold more than 50 students will typically need spanning elements more than 30 feet long. (Room capacities are based on providing individual 2-foot by 3-foot desks at student stations.)

(1) Partitions should be placed so that furnishings and training equipment are available in each subspace, and room features and controls are accessible from within each subspace. Each subspace should have electrical, television, and sound receptacles and controls, chalkboards, and other items for training. Partitions should be placed between windows and lighting fixtures.

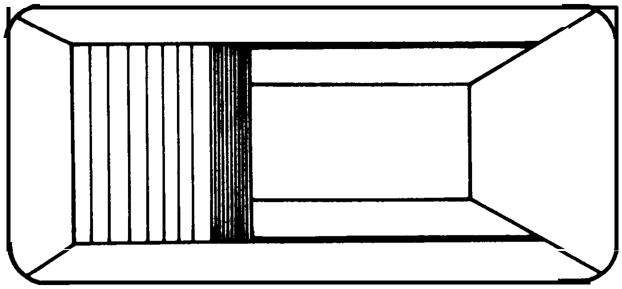
(2) Exits from a subspace must provide safe emergency egress and not disturb other subspaces. Each subspace must have an independent exit which opens directly into a corridor and does not pass through other subspaces. Most life safety standards consider operable walls, accordian-fold partitions, or a door in a partition between subspaces to be a second route of exit.

(3) Partition systems for subdividing large classrooms should be durable, easy to operate, and minimize sound transmission between subspaces. Partitions should have a sound transmission classification (STC) of 45 or greater. Seals around all edges (particularly along the floor and ceiling) are essential. (Figure 4-14).

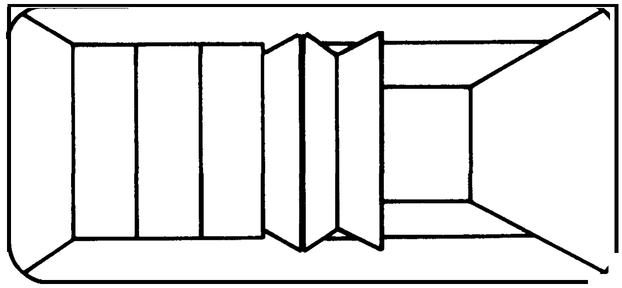
J. Furniture.

(1) Seating should be reasonably comfortable, but not so relaxing that it encourages inattentiveness (paragraph 3-3e above). Chairs with contoured seats and backs are more comfortable than those with straight seats and backs. The contours also keep the user facing forward because they cause discomfort when the user turns in other directions.

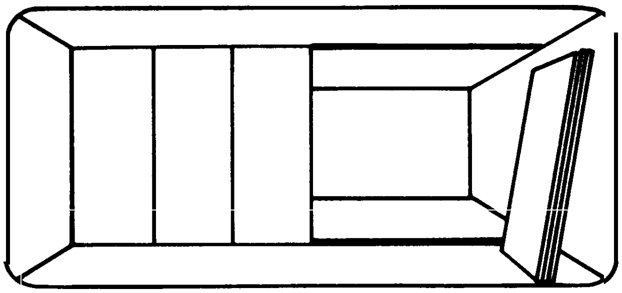
(2) Classroom furnishings should meet the needs of courses which use the classroom. The number of chairs, tables, or desks depends on the desired class size. The instructor's need to write material may be satisfied by products such as chalkboards, flipcharts, boards that use marker pens instead of chalk, electronic chalkboards, and overhead projectors with films that can be written on with wax pencil or special markers. The instructor's need to display papers and other visual aids may be satisfied by tackboards, tack strips along the top border of chalkboards, magnetic chalkboards, and special devices for hanging papers, maps, and charts. Some of these furnishings may be free standing and movable; others may be fixed to walls or hung from ceilings. (Figure 4-15).



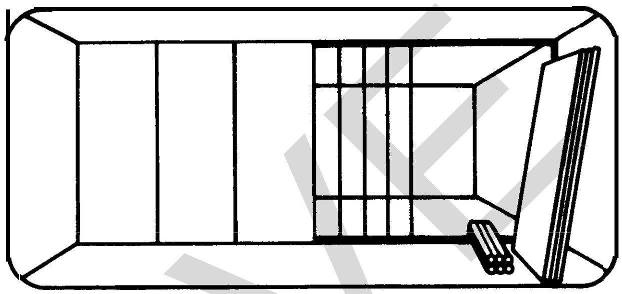
Operable Accordian Wall



Operable Stacking Panel Wall



Portable Panel



Movable Stud and Facing Panel Wall

Partition Type	Relative cost	Change Frequency			
		Hourly	Daily	Monthly	Yearly
Fixed (non-load bearing) 6" CMU 5" GWB	1	No	No	No	Yes
Moveable	1.8	No	No	Possible	Yes
Accordian	2.6	Yes	Yes	Yes	Yes
Portable	3.2	No	Possible	Yes	Yes
Folding Panel	5.4	Yes	Yes	Yes	Yes

Figure 4-14
Changeable Wall System.

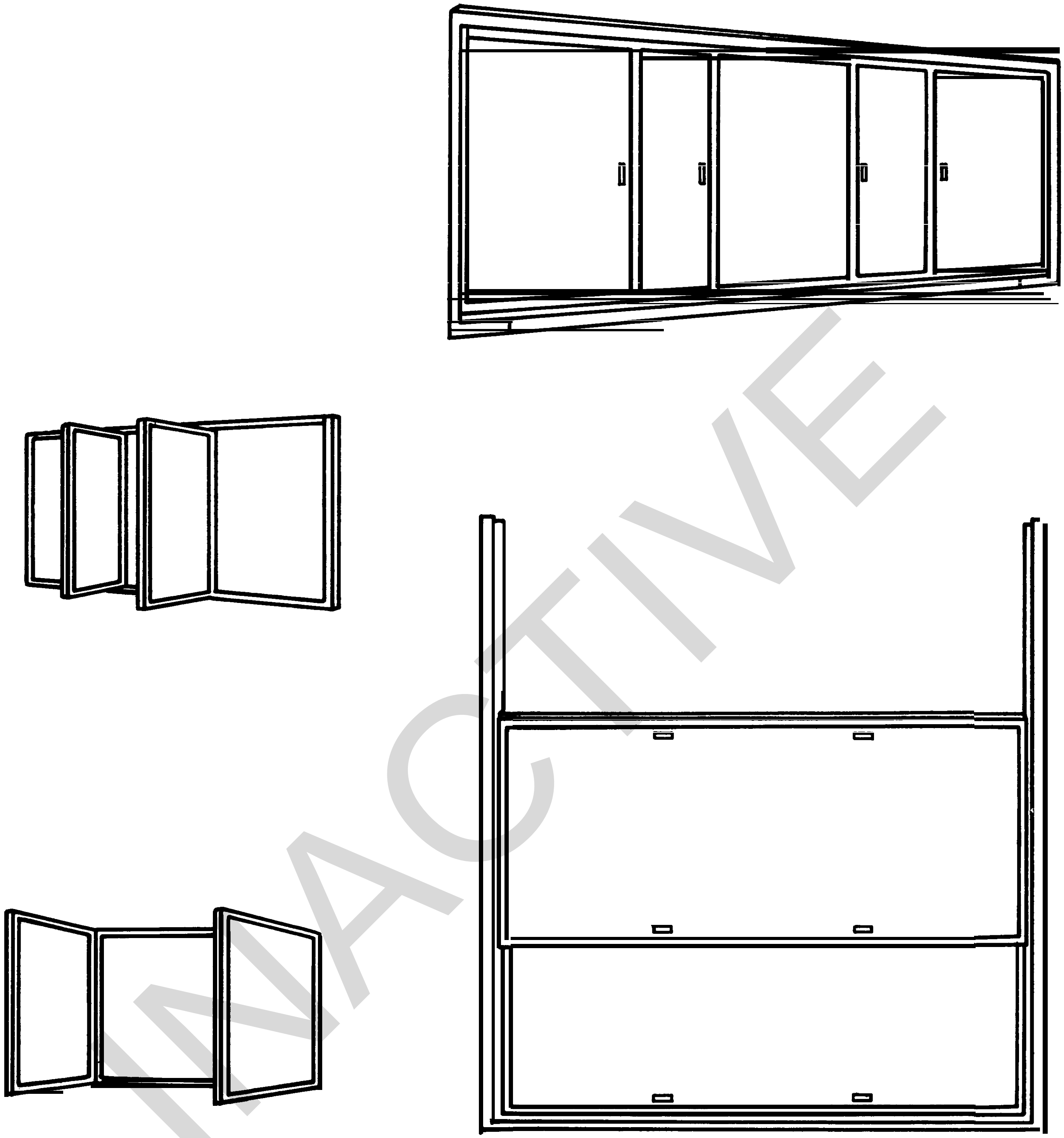


Figure 4-15
Examples of Chalkboards and Tackboards.

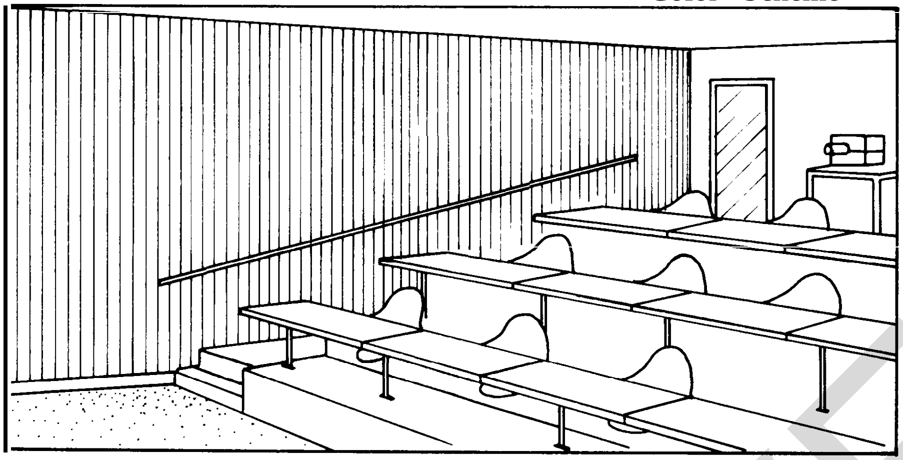
K. Interior Design.

(1) Finishes.

a. Floor should be attractive, easy to maintain, and functional. Although flooring materials can be used for sound control, final selection should include durability, wear, and ease of maintenance. Hard-surface flooring materials wear better, are less easily soiled, and are easier to clean; carpets and cushioned flooring have better sound control.

A	[redacted]	C	D
a	[redacted] b	a	b

Color Scheme



Interior Design Recommendations
Colors should be muted. Acoustical materials should be selected to coordinate with overall design scheme. Furniture and finishes should be durable for heavy use.

Room Finishes

Item	Recommended Characteristics
Walls	Use light colors. Flat paint is recommended to minimize glare.
Floor	Hard surfaces are recommended for easy maintenance.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs should be movable and comfortable.
Tables	Tables used by students should have laminated work surfaces with rounded or beveled endges.
Lighting	Spotlights should be used to accent the speaker and the demonstration areas.
Curtains	Blackout shades are recommended. Colors should coordinate with overall color scheme.

Figure 4-16
Interior Design Recommendations for Conference Classrooms.

Table 4-1 Criteria for Conference Classrooms.

Space Criteria	
Area/Student	25-35 s.f./student: based on seating with individual 2-ft. x 3-ft. desks, adequate circulation area, platform area (lecture or demonstration), A-V projection space and coat storage.
Ceiling Height	10 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Special Characteristics	Student sight lines are critical; depending on the size of audience and nature of the presentation, platforms for instructors and risers for seating may be required.
Seating Spacing	Reference: NFPA-101
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling), with each 750-s.f. class area having a thermostat.
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Chalkboard task lighting	50 fc. (maintained)
A-V lighting level	30 fc., reference: para 3-4f(2)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing wall sound rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 v
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

b. Interior finishes and colors should be selected to maintain acceptable levels of visual comfort (controlled reflectance properties and brightness ratios). Accepted methods of achieving visual comfort include painting ceilings, walls, woodwork, etc., to insure high light reflection; using matte rather than glossy paint; using satin rather than glossy wood finishes; using light-colored furniture and equipment; using light-colored tack- and chalkboards; using light-colored floors; having a multisource for daylight; making windows continuous; placing window heads flush with the ceiling; and using minimum-width window mullions.

(2) Recommendations.

a. For recommendations, see Figure 4-16. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

L. Criteria.
Table 4-1 lists outline criteria for designing conference classrooms.

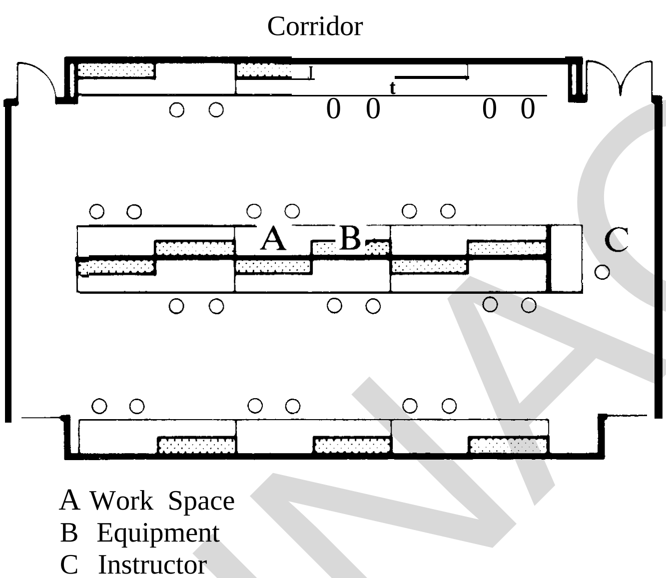


Figure 4-17
Laboratory Classroom With Group Stations.

4-3 Laboratory Classrooms.

A. Use/Activities.
The main use of laboratory classrooms is for "hands-on" training on small equipment (paragraph 2-2g(3) above). In some schools, part of the instruction in laboratory classrooms will be devoted to a lecture. Then students will go to another part of the room to apply the lecture material "first-hand" to a model, mockup, training aid, or real equipment. The equipment can be a single object installed in the room and surrounded by circulation and instruction areas, or it may be groups of individual or paired student stations.

B. Occupants.
The instructor-student ratio will vary with each course, but is typically about the same as for laboratories and shop, i.e., between 1:20 and 1:40.

C. Equipment/Supplies.
Typical equipment is found in most laboratory classrooms. However, specific equipment and supplies for laboratory activities will vary widely.

D. Space Utilization.

(1) A laboratory classroom should have enough area for both laboratory and lecture instruction. About 45 square feet should be allowed per student, but each room's needs will vary according to its equipment and the space required around it. The lecture area will require 25 to 35 square feet per student (see Section 4-2 above).

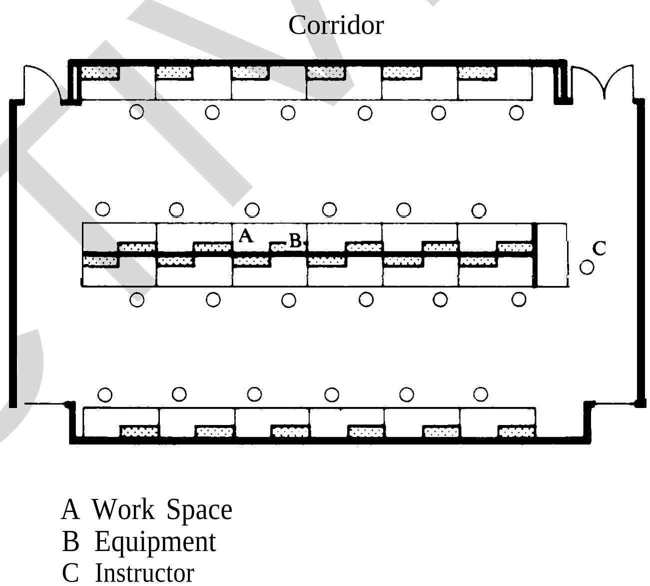


Figure 4-18
Laboratory Classroom With Individual Stations.

(2) The shape of the room must foster good use of space. In Figures 4-17 and 4-18 the layout shows grouped student stations placed for visibility toward room ends for display and instructor conference. Utilities for the groups should be provided to the backs of the stations from a single point overhead or through the floor. Laboratory classrooms are dedicated space to the extent that instruction is practically limited to using equipment in the space.

(3) The laboratories shown are contained in the standard classroom module, but any size that fits the school's structural system may be used since these are highly dedicated spaces. The standard laboratory casework may be planned on the 5-foot-square grid. When the nature of the work and length of the-class allow, a 10-foot spacing between the centerlines of counters may be used for stand-up work. (Figure 4-19). When seats are required, a 15-foot spacing should be used as shown in Figures 4-17 and 4-18.

A Work Space
B Equipment
C Instructor

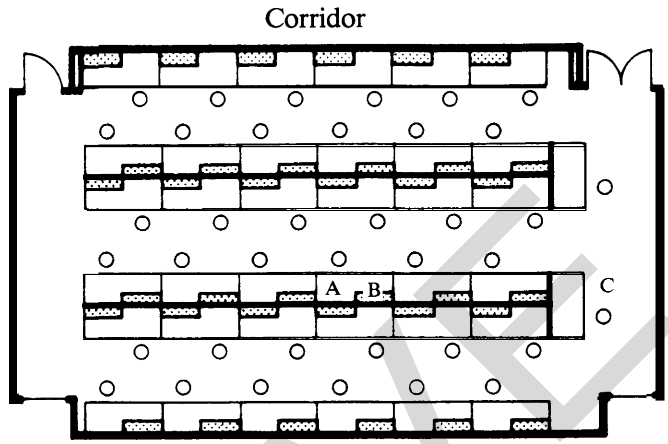


Figure 4-19
Laboratory Classroom for Standing Instruction.

E. Access/Circulation.

(1) Location.
Laboratory classrooms should be clustered into suites containing space for apparatus storage, preparation of demonstrations, and lectures. (Figure 4-20 and paragraph 5-2 below).

(2) Circulation.
Aisles should provide ease of movement between the classroom and laboratory areas and around the laboratory equipment. It should be possible to move equipment in and out easily. Circulation in a laboratory classroom must meet the same life-safety criteria as classrooms. Special doors may be needed to move laboratory equipment in or out of the room. Enough space should be provided around laboratory equipment so students can see well and to insure that material movement does not create hazards.

F. Interior Design.

(1) Recommendations:

a. For recommendations, see Figure 4-21. For color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

G. Criteria.
Table 4-2 lists outline criteria for designing laboratory classrooms.

4-4 Instructional Shops.

A. Use/Activities.
Instructional shops and laboratory spaces are enclosed spaces for conducting applied training in using and maintaining Army equipment. Laboratories generally refer to spaces where equipment is small and a number of similar workstations or work benches can be grouped into one room. Instructional shops generally refer to spaces for larger equipment and vehicles; students work in small groups or rotate among specialized locations. Because of this diversity, this guide cannot provide specific dimensional or loading criteria for laboratories/shops. However, the planning factors below pertain to shop design at all service schools .

B. Occupants.
The instructor-student ratio will vary between 1:40 and 1:20 or less.

C. Equipment/Supplies.
Most instructional shops house U.S. Army equipment for training use. Depending on the school, this equipment includes communication devices, computers, wheeled vehicles, artillery pieces, tracked and armored vehicles, guided missiles, and fixed and rotary-wing aircraft. Some shop areas house mockups instead of actual U.S. Army equipment items. These devices simulate, within a controlled environment, items of inventory equipment, especially field equipment. They are often made from parts of actual equipment and are partially operable; for example, the Armor School

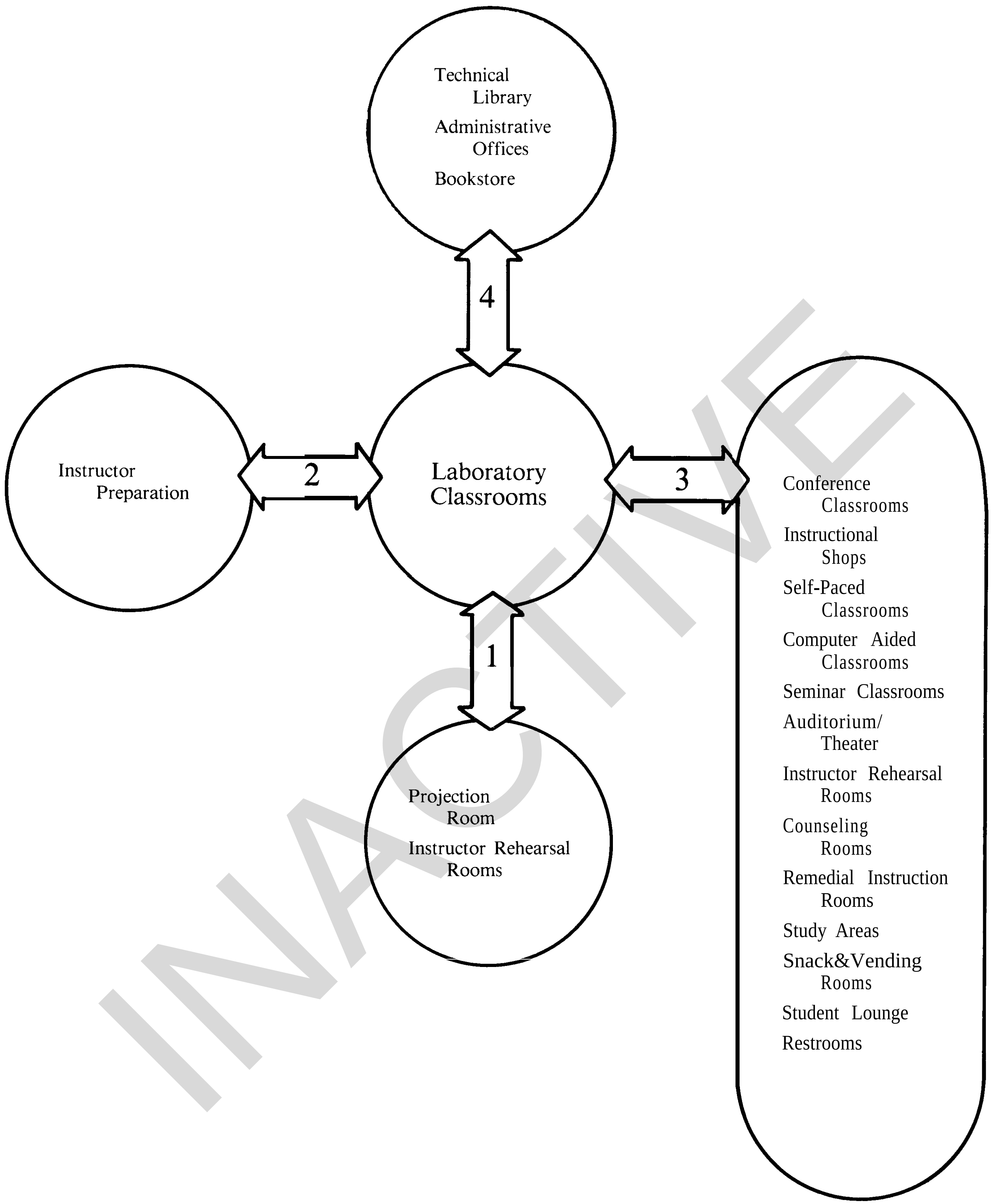
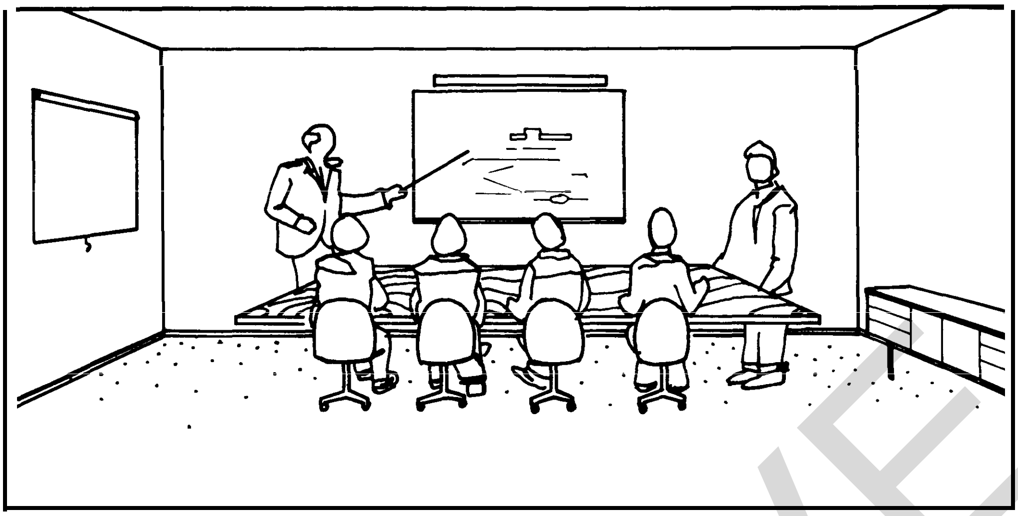


Figure 4-20
Spaces Near Laboratory Classrooms.

A		[redacted]	C		D	
a	b		a	b	a	b

Color Scheme



Interior Design Recommendations

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint in recommended colors or wallpaper corrdinated with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Comfortable, upholstered chairs on casters should be provided.
Tables	Use laminated plastic or wood veneer.
Curtains	Blackout shades are recommended. Colors should coordinate with the overall color scheme.

Figure 4-21
Interior Design Recommendations for Laboratory Classrooms.

Table 4-2 Criteria for Laboratory Classrooms.

Space Criteria	
Area/Student	30-60 s.f./student
Ceiling Height	10 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum) (fumes, smoke potential, excessive heat may require up to 100% exhaust)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Orientation of Windows	North or south
Acoustic	
Enclosing wall sound rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Walls:	Reflective
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

A Fire Protection
B Overhead Loading
C Special Exhaust
D Large Doors
E Equipment Movement
F Waste Utilities
G Large Equipment
(fixed or moving)
H Student Stations

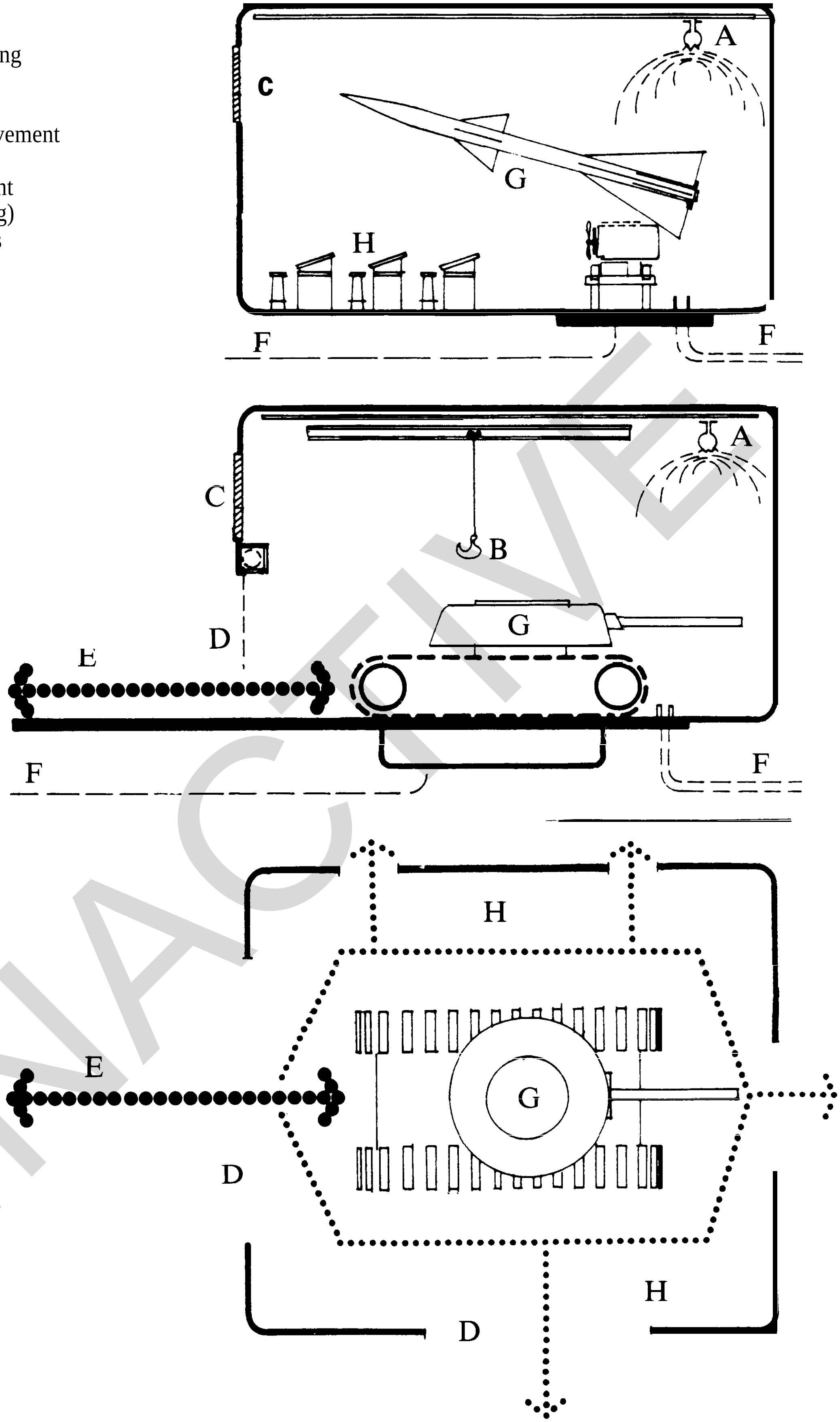


Figure 4-22
Design Considerations of Instructional Shop Spaces.

uses tank turrets mounted in shop areas to train personnel in aspects of tank gunnery and crew procedures. The same planning applies for both types of instructional shops. Spatial planning for both types of equipment must consider:

(1) Equipment Dimensions.

(2) Equipment Weight.

(3) Number of Equipment Items.

(4) Clearance for Movement of Equipment.

(5) Space Needed Around Equipment for Operation and Maintenance Training.

(6) Special Equipment, Controls, or Cable Limits.
Especially for mockup equipment, the spatial and mechanical/electrical requirements for devices which activate and control mockup equipment must be set. An example is special filtration and cleaning of air for laboratories/shops having optical or electrical equipment, general or local ventilation, or exhaust systems if fumes, smoke, other air contaminants, or excessive heat are present. (Figure 4-22).

D. Space Utilization.

(1) Size.
Teaching methods and student equipment should be carefully analyzed to determine how much laboratory space is needed. Standard space criteria are not set for this type of space because requirements vary with the subject matter being taught; this, in turn, determines the training devices, equipment, and aids to be used. The number of these items that will be used in the laboratory is determined by the student/equipment/ instructor ratios set for a course. Space requirements for each laboratory will be stated in terms of the size of training devices and equipment. They will include required floor area, ceiling and door height, power source, etc. Other space requirements include the amount of circulation space needed around each piece of equipment for its use and maintenance. (A general square foot estimate is 30 to 60 square feet per student and a ceiling height of 10 feet.) Movable partitions can be used to subdivide laboratory/shop space.

(2) Shape.
Whenever possible, the laboratory/shop should duplicate actual work setting. It may be hard to duplicate real work station and shop layouts in a school. Layouts should be checked to see if course goals and training methods are accommodated.

(3) Area Calculations.

a. Definitions.
A = Average number of students in each session.
B = Number of students assigned to each item of practice equipment or to each training aid.
C = Number of items of practice equipment or training aids required = $\frac{A}{B}$.
D = Square feet of floor area occupied by each item of practice equipment or each training aid (includes critical dimensions and clearances in all directions, safety requirements, aisles, and fire exits).
E = Square feet of floor area required for one student working on or around each item of practice equipment or each training aid.
F = Net square feet area of instructional laboratory.

b. Formula.
$[(B \times E) + D] \times C = F$.

c. Instructional Changes.
Add 20 percent allowance to F for instructional changes due to technology advances.

d. Graphic Layout.
A graphic layout should be made. The arithmetical square footage derived by the formula process can be deceiving; this is particularly so where circular or odd-shaped items of practice equipment and training aids are needed.

e. Human Engineering Factors.
Human engineering factors, including safety and lighting, should be considered at the start of the planning process.

E. Access/Circulation.
(Figure 4-23 and paragraph 5-2 below).

F. Storage.

(1) Size.
Shop areas with ample storage space should be provided. The amount of space required must be set for each school.

(2) Location.

a. Storage areas should be accessible to delivery vehicles. (Figure 2-10).

b. Storage areas should act as acoustic barriers between shops and other school activities. (Figure 5-4).

c. See paragraph 2-4c(2)(m) above for additional information on storage spaces.

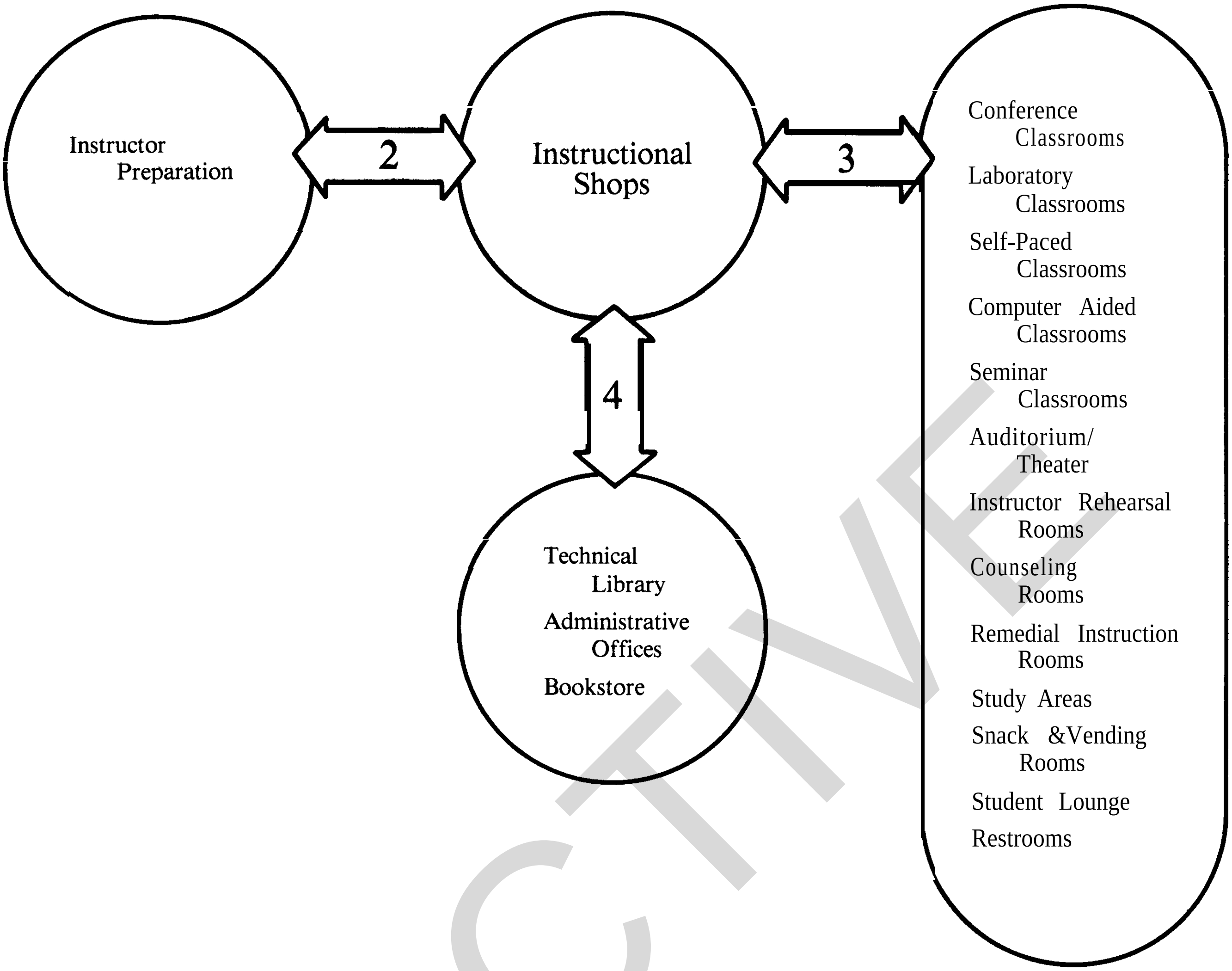


Figure 4-23
Spaces Near Instructional Shops.

(3) Openings and Access.

a. It should be easy to move equipment in and out of the laboratory/shop. Laboratories/shops which use vehicles or large equipment (i.e., that will not fit through a 3- or 6-foot-wide doorway) should have an overhead or track-mounted door. The door should allow direct entry to a shop from the outside.

b. A general circulation plan should be developed when buildings are changed for laboratories and shops. The advantages and disadvantages of outdoor and indoor routes should be compared. Outdoor routes require a drive and a door for each laboratory/shop area. Indoor routes may create vehicle-pedestrian traffic hazards and will use up space within the building; however, they will reduce the number of doors to the outside. Doors may increase energy use and ventilation for the building, depending on climate, laboratory/shop activities, and other factors.

c. General circulation among different spaces in the laboratory/shop should not disturb students who are working. A corridor or circulation route with training spaces on each side will reduce disturbances. Routes through training spaces should be avoided.

d. Floor systems should be designed to support expected heavy-equipment loads. When existing facilities are changed for laboratory/shop use, floor strength and other structural parts should be evaluated by a structural engineer to determine their capacity.

G. Furniture.
Furniture should be durable and easy to clean.

H. Interior Design.

(1) Finishes.
Walls and floors should be durable and easy to clean. Depending on laboratory/shop activities, surfaces may

need to be resistant to acids, alkaline material, greases, and solvents.

(2) Recommendations.

a. For recommendations, see Figure 4-24. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

I. Criteria.

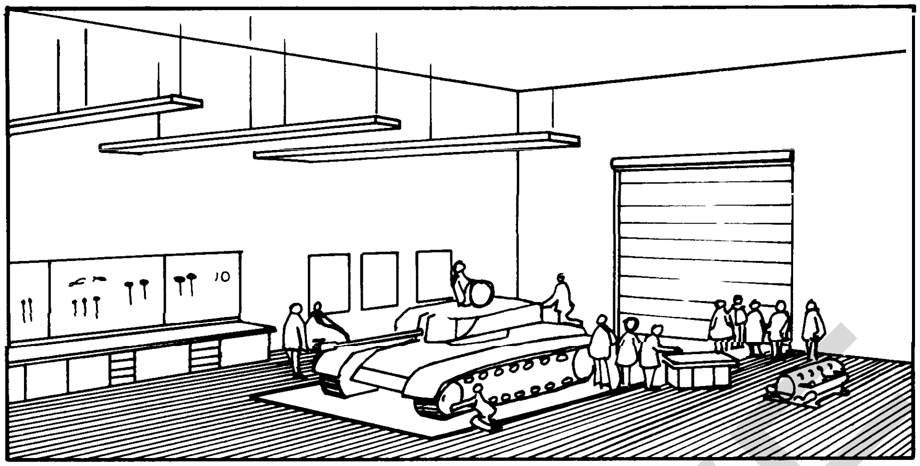
Table 4-3 lists outline criteria for designing instructional shops.

Table 4-3 Criteria for Instructional Shops.

Space Criteria	
Area	Reference: Paragraph 4-4d(2)
Environmental	
Thermal	
Temperature	65°F. (heating), mechanical ventilation for cooling
Outside air required/person	10 cfm (minimum)
Air changes	8 per hour (minimum)
Air pressure	Negative
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Daylighting	Yes
Window orientation	North or south
View in	No
Acoustic	
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Walls	Absorptive, NRC 25 (minimum)
Enclosing wall sound rating:	
Between shops and corridors	STC 40
Between shops and classrooms	STC 50
Service Criteria	
Electrical	
Power	110/ 120 V. Shops often require additional three-phase electrical power and 28 VDC for the simulated operation of equipment. The electrical conduit system serving shops should be designed so that additional power sources may be developed as required.

A	[redacted]	C	D
a [redacted]	b	a	b

Color Scheme



Interior Design Recommendations

Background colors should be muted.
Brighter colors should be used for worktables or benches, seating, and trim.
Caution or hazard areas should be clearly marked.
Furniture should be movable for maximum flexibility.

Room Finishes

Item	Recommended Characteristics
Walls	Painted concrete block or materials of similar durability should be used.
Floor	Hard, durable surfaces are recommended for easy maintenance and wearability.
Doors	Use durable hard wood or metal in recommended colors.
Trim	Use durable vinyl, hardwood, or metal in recommended colors.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Unupholstered, durable stools are appropriate.
Tables	Worktables with sturdy bases and replaceable wooden tops are recommended.
Lighting	Task lighting should be adjustable to provide flexibility.
Lockers	Metal locker units should be used if storage of student equipment or tools is required.

Figure 4-24
Interior Design Recommendations for Instructional Shops.

4-5 Self-Paced Instruction Rooms.

A. Use/Activities.

Self-paced instruction rooms allow students to master instructional material at their own rate. Students collect lesson materials from a control station, sit at an available carrel, and study, using A-V and written materials. Most self-paced instruction uses Training Extension Course (TEC) lessons. They consist of a pretest, viewing and listening to lesson topics, and a post-test. (TEC lessons may require the students to write.) After completing a lesson with an adequate performance level on the post-test, students return the TEC lesson to the control point and collect their next lesson. Each student is logged in and out by the classroom staff; the staff also maintains a progress chart on each student, verifies test performance, and monitors carrel activities. In some cases, the staff may give specific instructions to a group or to one person at a special carrel.

B. Occupants.

The number of students in this type of space can vary greatly. The upper limit is the number of carrels which can be monitored and managed from a control point. Some self-paced instructional spaces may be designed for only one or two students. Depending on program requirements, classroom staff typically will include instructors and clerks. Usually only one or two staff members will operate a control point.

C. Equipment/Supplies.

Self-paced instruction rooms contain special carrels equipped with A-V aids and a writing surface. The number of carrels in a room will vary with the student load. Power requirements and heat generated can be large when many carrels are together. Special carrels with demonstration, simulation, mockups, or other training aids may be needed. The staff area (control station) may include a desk, checkout counter, storage shelves for lesson materials, and files and racks for maintaining student progress charts.

D. Space Utilization.

(1) Size.

Self-paced instructional spaces should be sized to meet training objectives and provide for administration, service, storage, security, and custodial needs. Carrels will be used as stations for individual study or with group programs of instruction. In either case, the carrel may be a 4-foot by 3-foot position, suitable for reading material, or a 4-foot by 4-foot position, the minimum suitable for a unit that includes A-V aids.

(2) Arrangement.

Carrels shall be arranged to minimize distractions from room circulation patterns; they shall not be located along primary room circulation routes (Figure 4-25). A-V carrels require an acoustical separation on four sides; they should not be double-loaded on a single aisle. The minimum area required per A-V station is 32 square feet. Reading carrels may be grouped back-to-back on double-loaded aisles. The minimum area required per reading station is 25 square feet. About 200 square feet of space is needed for instruction, storage, and circulation.

A 4 Ft. A-V Carrels
B 3 Ft. Reading Carrels
C Instructor's Desk
D Primary Circulation
E Privacy Curtain

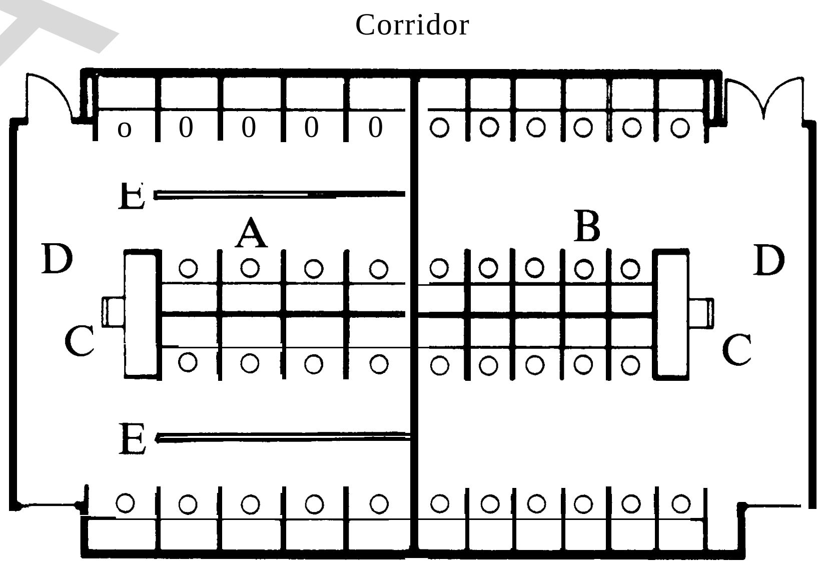


Figure 4-25
Instruction Carrels in Self-Paced Instruction Classroom.

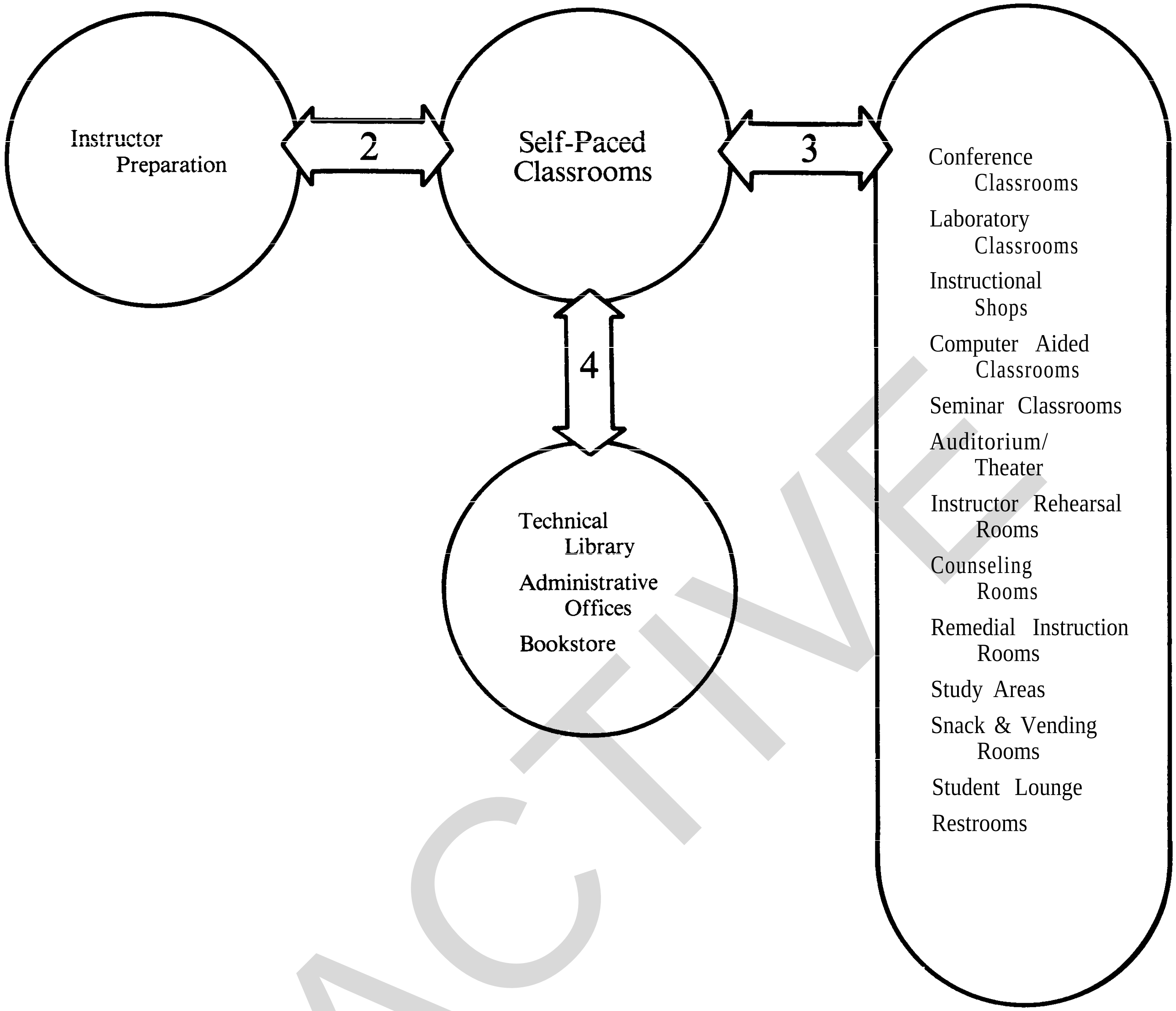


Figure 4-26
Spaces Near Self-Paced Instruction Rooms.

(3) Allocation.
There should be enough space for an instructor's desk, storage units for printed and A-V training material, and circulation. About 200 square feet will be needed for instructors and clerks, storage, and circulation around the control station.

E. Access/Circulation.

(1) Location.
Programs of instruction which combine self-paced and other forms of instruction in a coordinated manner should be located to best meet training goals. Self-paced instructional spaces should be near laboratories, shops, classrooms, or work areas as required by course plans. (Figure 4-26 and paragraph 5-2 below).

(2) Circulation Within Room.

a. Student distractions should be minimized. Carrels should not be in or near a room's primary circulation routes. Reading carrels can be double-loaded onto an aisle.

b. Instructors' desks and training material storage should be placed where they will ensure convenient log-in procedures or student acquisition of materials. Circulation routes from study carrels to exits should pass the control station; however, there should be enough space around the control station that traffic does not back up into the carrel area.

F. Utilities.
Electrical services are needed at carrels for audio-visual equipment and a slide viewer. Location and routing of electrical lines should allow for flexibility. Carrel equipment power demands should be analyzed carefully. Number of receptacles required at each carrel should be coordinated with the equipment expected to be used there, but typical carrel demands require three outlets per carrel.

G. Environmental Conditions.

(1) Lighting.
The general lighting level should be 30 foot-candles. Lighting levels in carrels should be 50 foot-candles. No task lighting is required if carrels do not have shelves mounted above the work surfaces. If shelves are mounted above the work surface, task lighting should be incorporated into the carrel design.

(2) Acoustic.
Acoustical control is essential to permit listening at normal conversational levels. Noise distractions from within and outside the room should be minimized. Control of noise from A-V equipment is very important. Audio-visual carrels require acoustical separation on all four sides. Acoustical panels between rows of carrels may also be needed. Ambient levels should not exceed 40 decibels; a continuous background noise level of 30 decibels is preferred. Carpets and acoustical ceiling material are recommended to control noise. Walls between rooms should have an STC rating of 45. Walls between self-paced instructional rooms and corridors should have an STC rating of 40.

(3) Thermal.

a. Waste heat from A-V and other equipment may need to be removed. Carrels should be designed to allow air circulation along the floor. Carrel panels should be at least 8 inches from the floor.

b. Certain types of training programs may require interconnections between carrel equipment and an instructor station, computer, or other locations. Space should be provided for cable and power wiring runs.

H. Storage.
Self-paced instruction rooms and carrels should have space for students' personal belongings. Each carrel should have a bookshelf or book rack for study materials.

I. Furniture.

(1) Carrels containing frequently used or highly specialized equipment or materials may be dedicated.

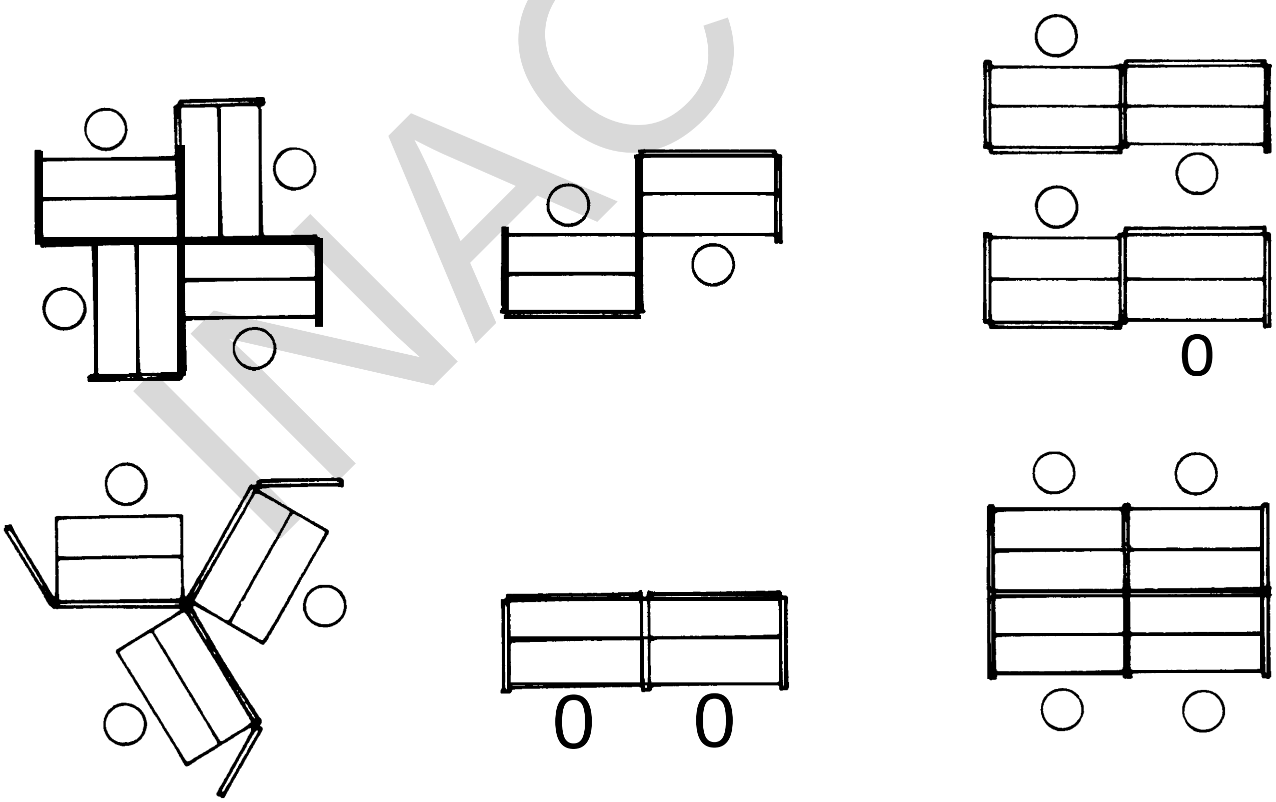
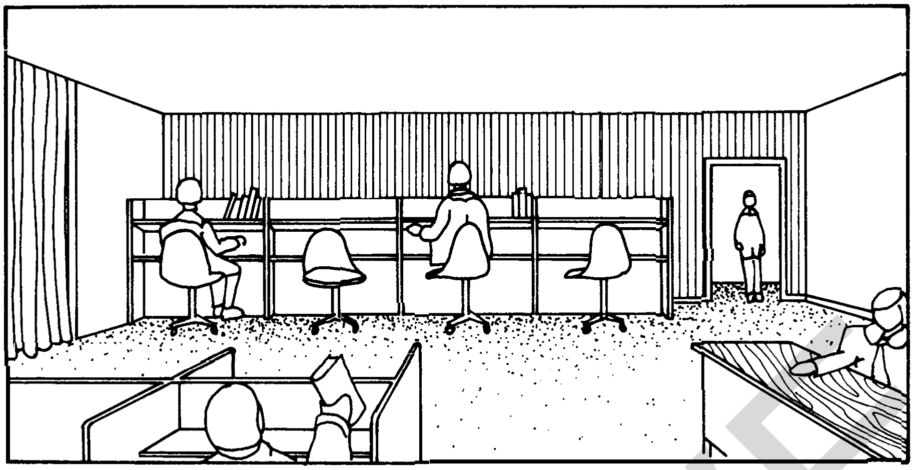


Figure 4-27
Carrel Layouts.

A	B	C	D
b	a	a	b

Color Scheme



Interior Design Recommendations

Physical, visual, and auditory comfort are very important in self-paced instruction rooms. The total environment should be conducive to study.

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint to reduce glare or wallcoverings coordinated with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	A comfortable upholstered, swivel chair on casters is recommended for each carrel.
Lighting	Lighting needs to be carefully designed to meet the task requirements of this room. Glare and over-lighting need especially to be avoided.
Carrels	Use laminated plastic or wood veneer.
Curtains	Open weave curtains are recommended to limit direct sunlight. Colors should coordinate with the overall color scheme.

Figure 4-28
Interior Design Recommendations for Self-Paced Instructional Classrooms.

Otherwise, carrels should be suitable for using a variety of equipment and devices.

(2) Carrels must be designed to meet learning objectives, training tasks, and equipment requirements. Reading carrels should be 2 by 4 feet (minimum). Reading carrels should be grouped back-to-back or in clusters. Audio-visual carrels should be 2 l/2 by 4 feet (minimum); this may vary with the type of A-V equipment being used and the need for a writing surface. Carrels with A-V aids require acoustical separation on all four sides. (Figure 4-27).

J. Interior Design.

(1) Finishes.
The reflectance level of carrel surfaces should be minimal. Surface reflectance should not exceed 35 to 50 percent.

(2) Recommendations.

a. For recommendations, see Figure 4-28. For example color schemes called out in the figure, see the Appendix.

Table 4-4 Criteria for Self-Paced Instruction Classrooms.

Space Criteria	
Area/Student	
Hot (wired) carrels	32 s.f.
Reading carrels	25 s.f.
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68ºF. (heating), 78ºF. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task-carrel lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing wall sound rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V; 330 volt-amperes per carrel (minimum)
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

b. For general guidance on interior design, see DG 1110-3-122.

K. Criteria.
Table 4 lists outline criteria for designing self-paced instruction classrooms.

4-6 Computer-Aided Instruction Rooms.

A. Use/Activities.
Computer-based instruction rooms allow students to master instructional material at their own rate using either computer presentation/simulation or computer presentation and training aids (mockup or other). Students collect lesson materials from a control station, sit at an available carrel, and study. Most computer-based instruction uses post-test lessons. After completing a lesson with an adequate performance level on the post-test, students return the lesson to the control point and collect their next lesson. Each student is logged in and out by the classroom staff; the staff also maintains a progress chart on each student, verifies test performance, and monitors carrel activities. In some cases, the staff may give specific instructions to a group or to one person at a special carrel.

B. Occupants.
The number and age of user in this type of space can vary greatly. The upper limit is the number of carrels which can be monitored and managed from a control point. Some computer-based instructional spaces may be designed for only one or two students. Classroom staff will typically include instructors and clerks, depending on program requirements. Usually, only one or two staff members will operate a control point.

C. Equipment/Supplies.
Computer-based instruction rooms contain special carrels equipped with interactive, video-disk microcomputer units, plato terminals, or microcomputer alone. The number of carrels in a room will vary with student load. Power requirements and heat generated can be large when many carrels are located together. Special carrels with demonstration, simulation, mockups, or other training aids may be needed. The staff area (control station) may include a desk, checkout counter, and storage shelves for lesson materials.

D. Space Utilization.

(1) Size.
Computer-based instruction spaces should be sized to meet training objectives and provide for administration, service, storage, security, and custodial requirements. Carrels will be used as stations for individual study or with group programs of instruction. In either case, the carrel may be a 5-foot by 2-1/2 foot rectangular position (the minimum suitable for a unit that includes a microcomputer with terminal) or an angular type. (Figures 4-29 and 4-30).

(2) Arrangement.
Carrels shall be placed to minimize distractions from circulation patterns in the room; they shall not be located along primary room circulation routes. (Figure 4-25). Audio-visual carrels require an acoustical separation on four sides and should not be double-loaded on a single aisle. The minimum area needed per computer station is 23 square feet.

(3) Allocation.
There should be enough space for an instructor's desk, storage units for printed and A-V training material, and circulation. About 200 square feet will be needed for instructors and clerks, storage, and circulation around the control station.

E. Access/Circulation.

(1) Location.
Programs of instruction which combine computer-based and other forms of instruction in a coordinated manner should be located to best meet training goals. Computer-based instructional spaces should be near laboratories, shops, classrooms, or work areas as required by course plans. (Figure 4-31).

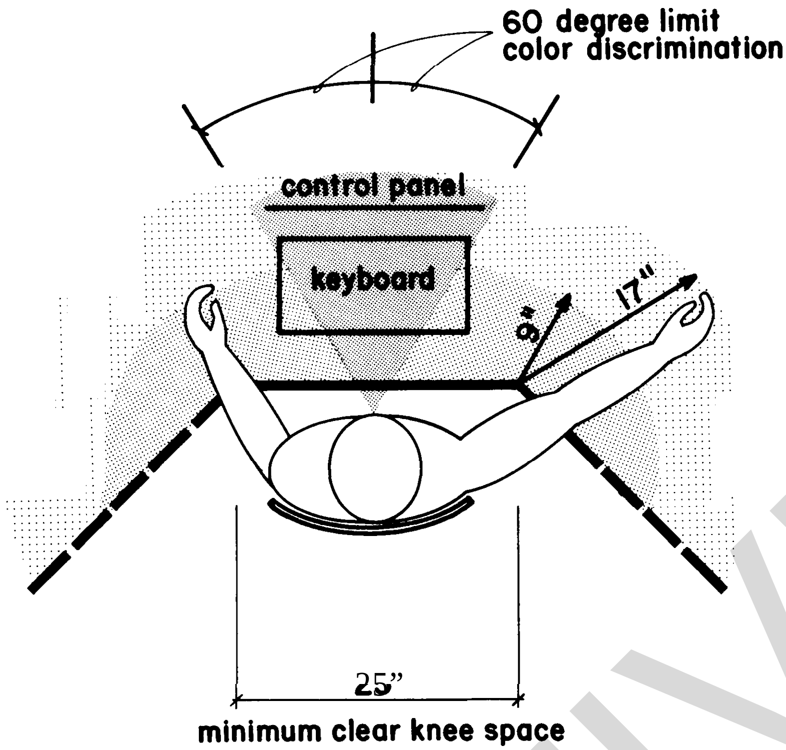
(2) Circulation Within Room.

a. Student distractions should be minimized. Carrels should not be in or near a room's primary circulation routes. Reading carrels can be double-loaded onto an aisle.

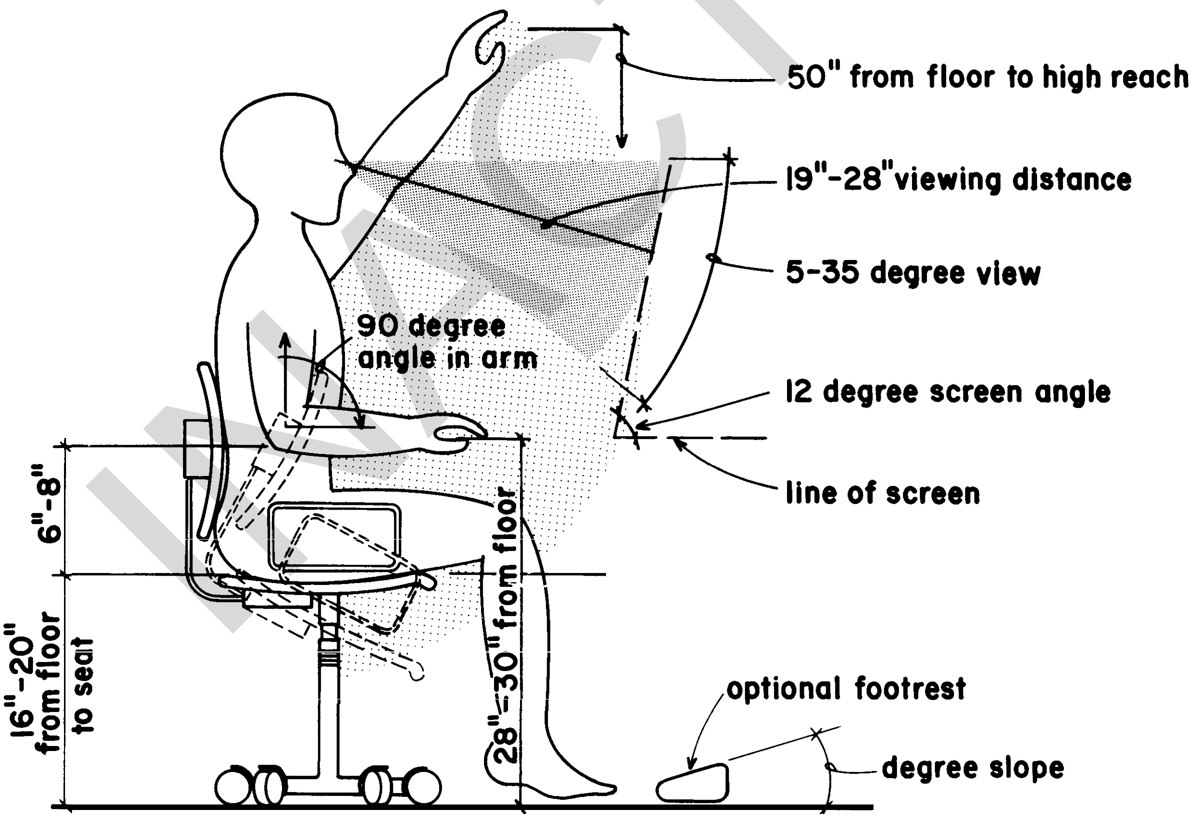
b. Instructor's desks and training material storage should be placed where they will insure convenient log-in procedures or student acquisition of materials. Circulation routes from computer carrels to exits should pass the control station; however, there should be enough space around the control station so that traffic does not back up into the carrel area.

F. Utilities.

(1) Electrical Wiring.
Electrical services are needed at carrels for microcomputers and peripheral equipment. Location and routing of electrical lines should allow for flexibility. Carrel equipment power demands should be analyzed carefully. Number of receptacles required at each carrel should be coordinated with the equipment expected to be used there, but typical carrel demands require three outlets per carrel.

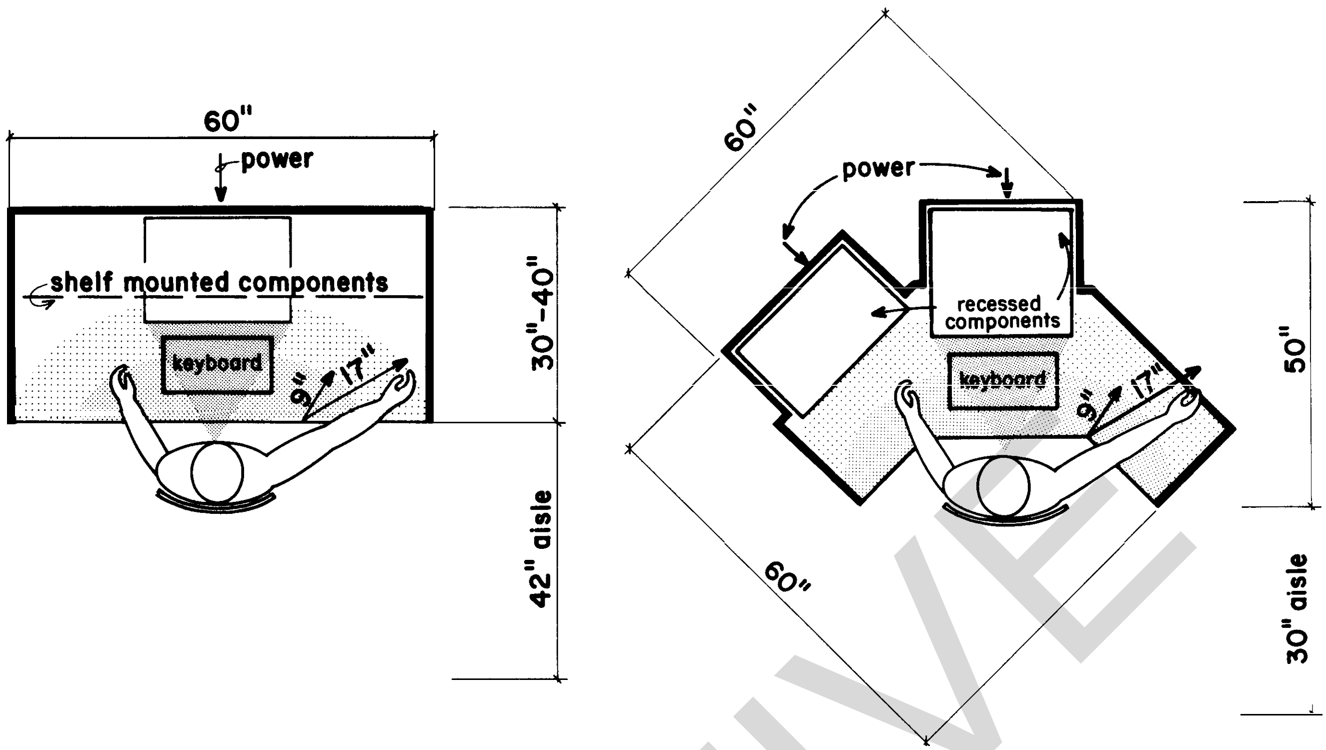


Plan View

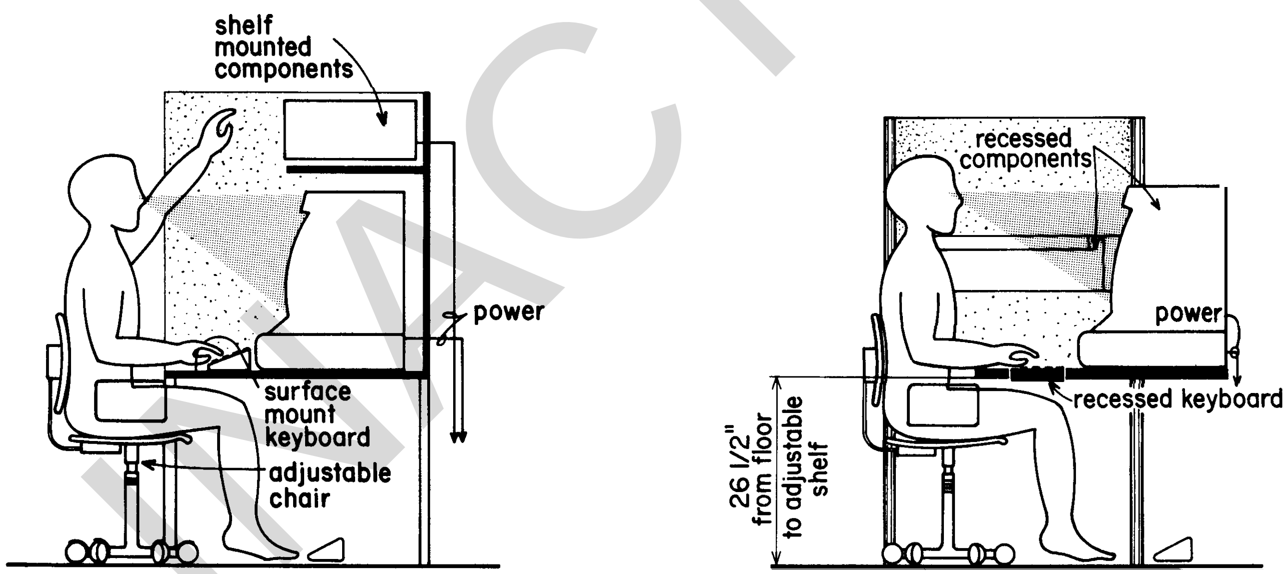


Side View

Figure 4-29
Human Design Factor Dimensions for Computer-Aided Instruction Carrels.



Plan View



Sectional View

Figure 4-30
Comparison of Angular and Rectangular Carrels.

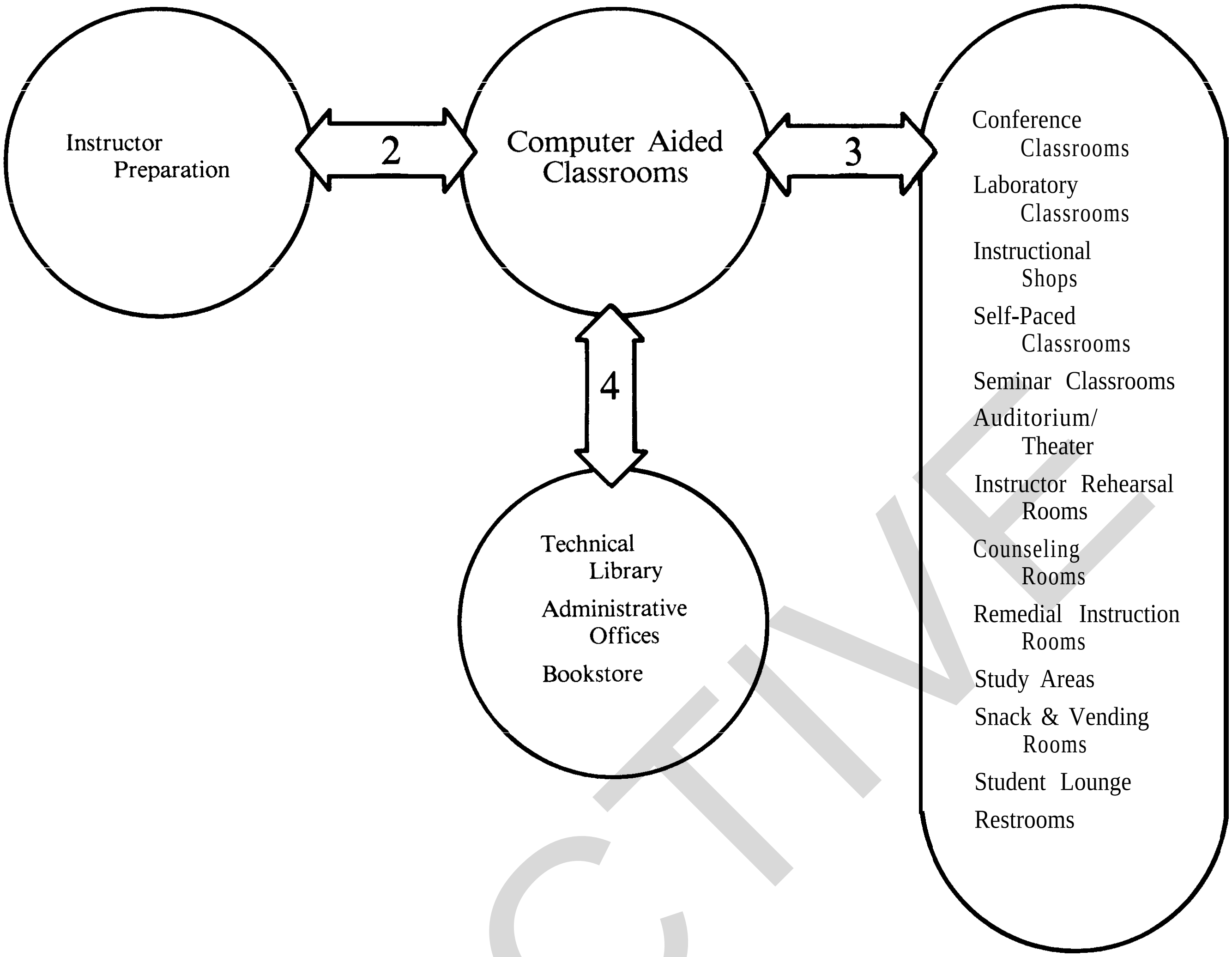


Figure 4-31
Spaces Near Computer-Aided Instructional Classrooms.

(2) Surge Protection.
Electrical power to classrooms using microcomputer-based instruction should be protected from surges in electrical voltage by a lightning arrester/surge protector. Surge protection may be incorporated in the electrical line filter. Microcomputers in instruction classrooms should not be supplied by electrical circuits which also supply power for electrical motors or electrical devices which automatically cycle on or off (such as coffee pots, photocopy machines, etc.).

(3) Standby Power.
Electrical power to classrooms using microcomputer-based instruction may need to be protected from sags or drops in electrical voltage by the use of standby power sources. Such protection is only needed when individual microcomputers will be used for extremely long tasks using data that would be difficult to replace if lost.

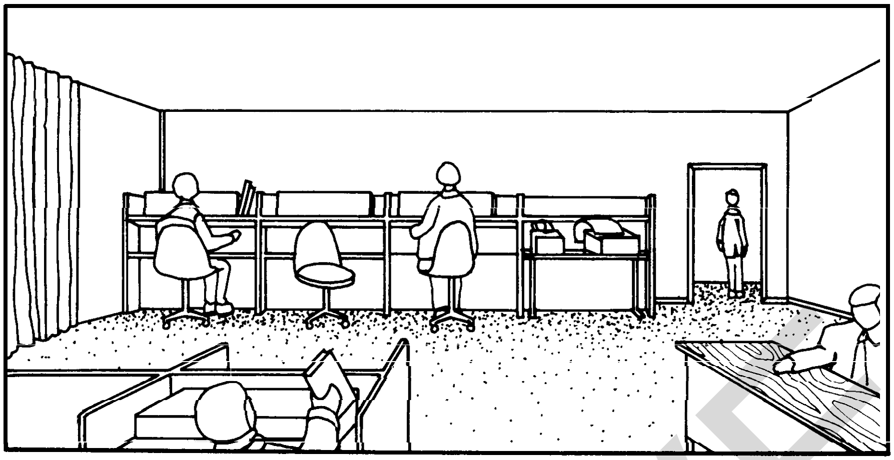
(4) Electrical Line Filtering.
Electrical power to classrooms using microcomputer-based instruction should be protected from interference by an electrical line filter. The line filter may incorporate the surge protector. Computers may have individual line filters. Filters may be for grouped computers, or the entire circuit for all microcomputers in the classroom may be protected.

G. Environmental Conditions.

(1) Lighting.
The general lighting level should be 30 foot-candles. Lighting levels at carrels should be 50 foot-candles. No task lighting is required if carrels do not have shelves mounted above the work surfaces. If shelves are mounted above the work surface, task lighting should be incorporated into the carrel design.

A	B	C	D
b	a	a	b

Color Scheme



Interior Design Recommendations

Physical, visual, and auditory comfort are very important in computer-aided instruction rooms. The total environment should be conducive to study.

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint to reduce glare or wallcoverings coordinated with the overall interior design scheme.
Floor	Use recommended static free carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	A comfortable upholstered, swivel chair on casters is recommended for each carrel.
Carrels	Use laminated plastic or wood veneer.
Lighting	Lighting needs to be carefully designed to meet the task requirements of this room. Glare and over-lighting need especially to be avoided.
Curtains	Open weave curtains are recommended to limit direct sunlight. Colors should coordinate with the overall color scheme.

Figure 4-32
Interior Design Recommendations for Computer-Aided Instructional Classrooms.

(2) Acoustics.
Acoustical control is essential to permit listening at normal conversational levels. Noise distractions from within and outside the room should be minimized. Control of noise from A-V equipment is very important. A-V carrels require acoustical separation on all four sides. Acoustical panels between rows of carrels may also be needed. Ambient levels should not exceed 40 decibels; a continuous background noise level of 30 decibels is preferred. Carpets and acoustical ceiling material are recommended to control noise. Walls between rooms should have an STC rating of 45. Walls between self-paced instructional rooms and corridors should have an STC rating of 40.

(3) Thermal.
Waste heat from computer and other equipment will need to be removed. Carrels should allow air circulation along the floor. Carrel panels should be at least 8 inches from the floor.

H. Storage.

(1) Each interactive video-disk microcomputer will have a storage case. Storage cases for all interactive video-disk microcomputer units should be close to their point of use. Each storage case requires about 14 cubic feet of storage space.

(2) Self-paced instruction rooms and carrels should accommodate students' personal belongings. Each carrel should have a bookshelf or book rack for study materials.

I. Furniture.

(1) Carrels containing frequently used or highly specialized equipment or materials may be dedicated. Otherwise, carrels should be suitable for using a variety of equipment and devices.

(2) Carrels must be designed to meet learning objectives, training tasks, and equipment requirements. Computer carrels should be 5 by 2 1/2 feet (minimum for rectangular); this may vary with the type of computer equipment used and the need for a writing surface. Reading carrels should be grouped back-to-back or in clusters. Carrels with A-V aids require acoustical separation on all four sides.

J. Interior Design.

(1) Finishes.
The reflectance level of carrel surfaces should be minimal. Surface reflectance should not exceed 35 to 50 percent.

(2) Recommendations.

a. For recommendations, see Figure 4-32 and 5-2. For example color schemes called out in the figures, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

K. Criteria.
Table 4-5 lists outline criteria for designing computer-aided instruction classrooms.

4-7 Seminar Classrooms.

A. Use/Activities.
Seminar classrooms are used for small group discussions, briefings, or debriefings. They can also be used for counseling and remedial instruction.

B. Occupants.
Typically, fewer than 20 people will use this type of space; larger groups cannot have effective seminar-type discussions.

C. Equipment/Supplies.
This space will usually require one or more tables with chairs. Audio-visual equipment and wall-mounted graphics and media may sometimes be used.

D. Space Use.

(1) Size.
The minimum space required is about 20 square feet per person. Rooms should be planned for seminars of up to 12 persons. A seminar of this size will generate an average participation level of 92 percent; a 25-person seminar will average 75 percent.

(2) Shape.
The room shape should be slightly rectangular to provide the greatest flexibility of layouts. For a 12-person room, 15 feet by 16 feet is best. (Figure 4-33).

E. Access/Circulation.
Seminar rooms should be near instructor preparation rooms. They are also appropriately located near shop and laboratory classrooms; they can then be used to discuss assignments and objectives when there is other activity in these areas. (Figure 4-34).

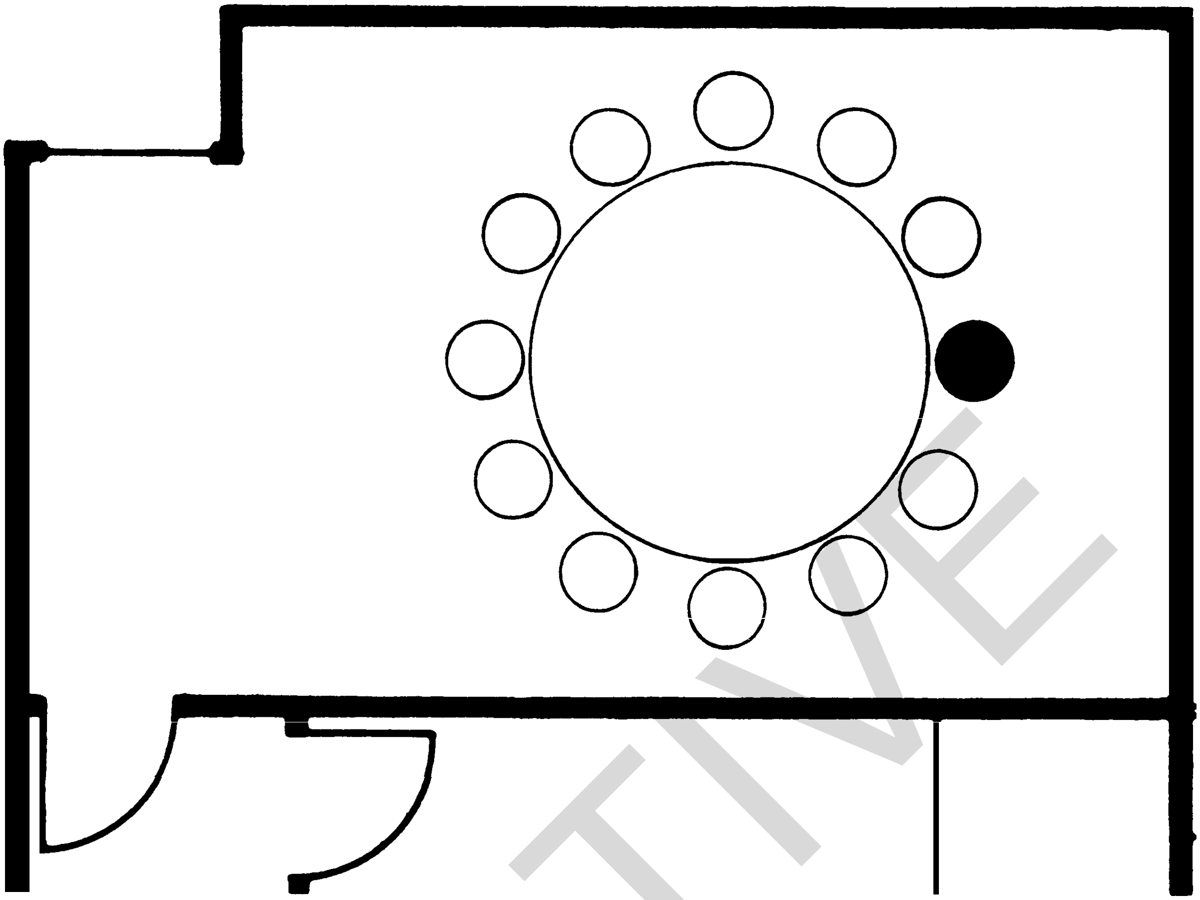


Figure 4-33
Seminar Classroom.

F. Environmental Conditions.

(1) Windows
Although views to the outside and natural lighting are not required, they are desirable. There is a greater feeling of spaciousness in a small room when there is a view to the outside. If windows operate and have screens, they will provide natural ventilation. Natural lighting will also provide the more relaxed and informal setting appropriate for a seminar classroom. Blinds or other light-omitting devices should be used as needed to block out daylight.

(2) Lighting.
Lighting levels should be adequate for reading and help create a relaxed and informal setting. The required lighting level is 50 foot-candles. Studies have shown that incandescent lighting, which has a psychologically warm color spectrum, creates relaxed and informal settings when used alone or with fluorescent lighting and accent lighting on walls.

G. Furniture.

(1) Effect on Group Dynamics.
In a seminar setting, where participants are to have an equal status or are to be drawn into the discussion, type and arrangement of furniture can affect group dynamics. Good eye contact among group members will promote interaction. Rectangular tables create dominant table positions at their ends. However, square tables and table arrangements reduce dominant positions, encourage subgroup formation, and improve eye contact in the group. Round tables result in best eye contact and make all seating positions equal.

(2) Shape and Arrangement.

a. It should be possible to arrange furniture in different ways to accommodate different numbers of students. Rectangular tables provide much flexibility in seating arrangements; round and square tables do not.

b. Furniture arrangement and size should promote interaction. Table size should allow the group to talk casually, without raising their voices, see details of each other's facial expressions, and pass written materials back and forth across the table. (Figure 4-35).

Table 4-5 Criteria for Computer-Aided Instructional Classrooms.

Space Criteria	
Area/Student	
Computer carrels	32 s.f.
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68ºF. (heating), 78ºF. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task-carrel lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Electrical	
Power	110 V; 330 volt-amperes per carrel (minimum)
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

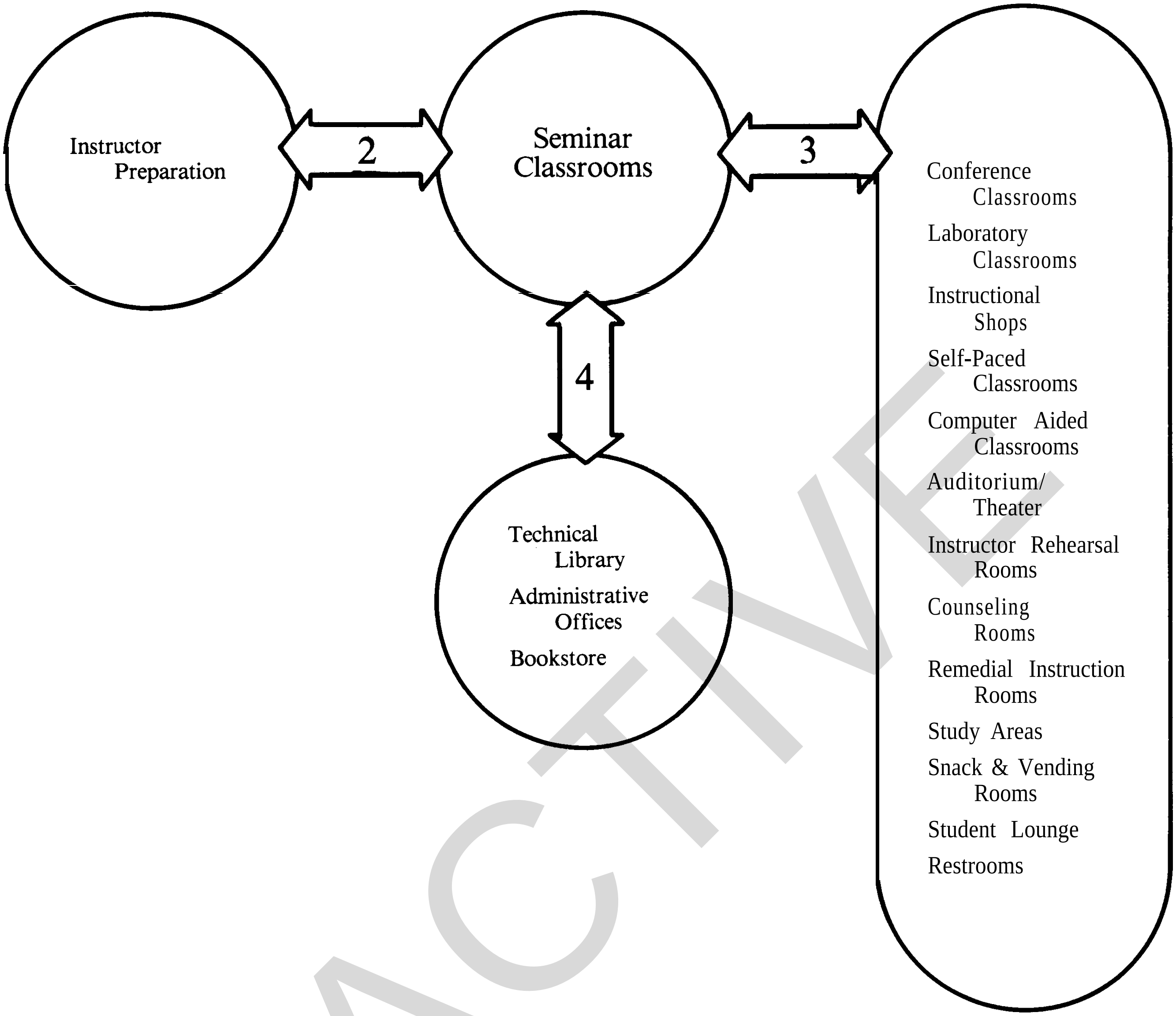


Figure 4-34
Spaces Near Seminar Classrooms.

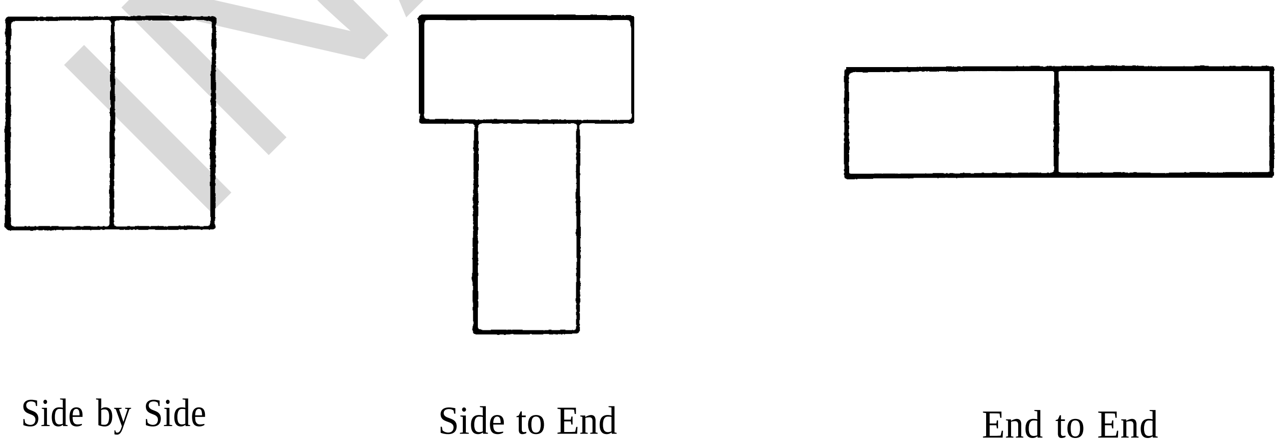
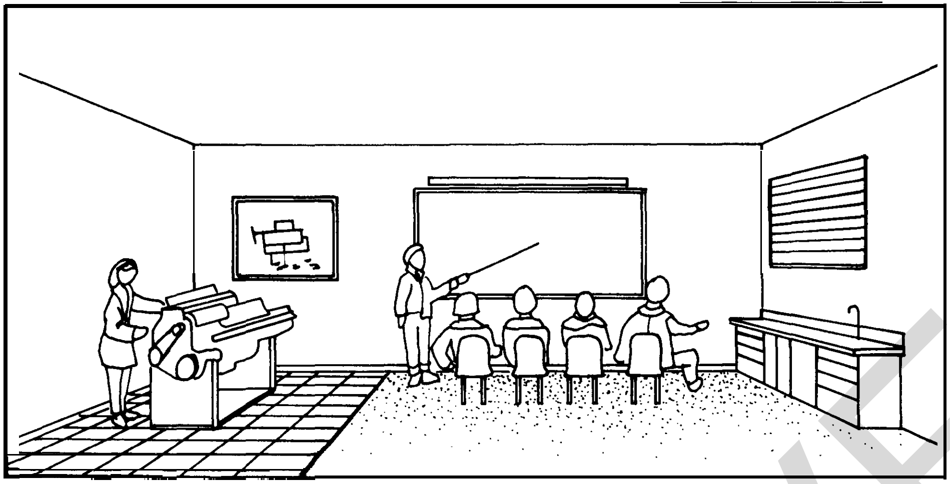


Figure 4-35
Table Arrangements.

A	[redacted]	C	D	
a	[redacted]	b	a	b

Color Scheme



Interior Design Recommendations

Background colors should be muted.
Brighter colors should be used for seating, tables, and trim.
Caution or hazard areas should be clearly marked.

Room Finishes

Item	Recommended Characteristics
Walls	Painted concrete block or materials of similar durability should be used in lab area. All wall surfaces should be washable.
Floor	Hard, durable surfaces are recommended for easy maintenance and wearability. Seating area may be vinyl flooring.

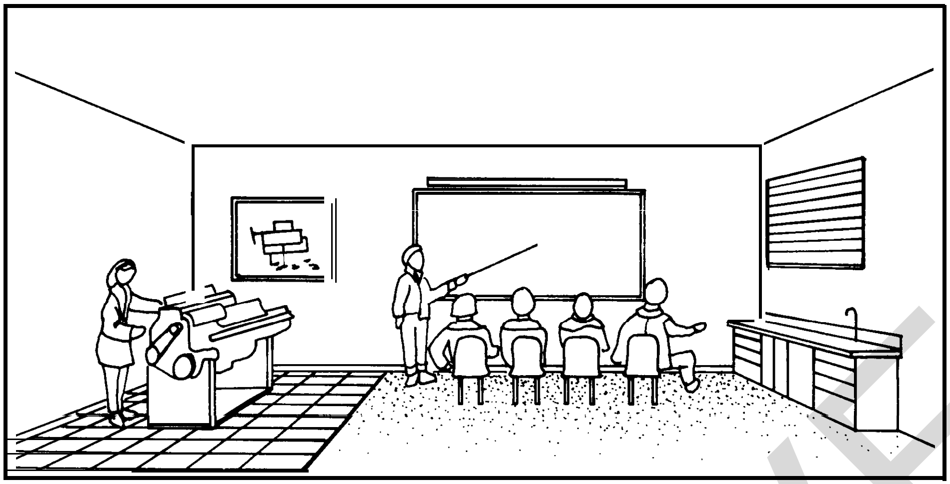
Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs should be vinyl covered or plastic for easy cleaning. Stackable or foldable seating will also allow flexibility.
Lighting	Task lighting should be adjustable to provide flexibility.
Lockers	Metal locker units or built-in cabinets should be used for storage of equipment and tools.
Curtains	Blackout shades are recommended. Colors should coordinate with overall color scheme.

Figure 4-36
Interior Design Recommendations for Seminar Classrooms.

A	[redacted]	C	D	
a	[redacted]	b	a	b

Co o S heme



Interior Design Recommendations

Background colors should be muted.
Brighter colors should be used for seating, tables, and trim.
Caution or hazard areas should be clearly marked.

Room Finishes

Item	Recommended Characteristics
Walls	Painted concrete block or materials of similar durability should be used in lab area. All wall surfaces should be washable.
Floor	Hard, durable surfaces are recommended for easy maintenance and wearability. Seating area may be vinyl flooring.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs should be vinyl covered or plastic for easy cleaning. Stackable or foldable seating will also allow flexibility.
Lighting	Task lighting should be adjustable to provide flexibility.
Lockers	Metal locker units or built-in cabinets should be used for storage of equipment and tools.
Curtains	Blackout shades are recommended. Colors should coordinate with overall color scheme.

Figure 4-36
Interior Design Recommendations for Seminar Classrooms.

H. Interior Design.

(1) For recommendations, see Figure 4-36. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-6 lists outline criteria for designing seminar classrooms.

Table 4-6 Criteria for Seminar Classrooms.

Space Criteria	
Area/Student	20 s.f.
Ceiling Height	8 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	30-70%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task-carrel lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Optional
Acoustic	
Enclosing sound wall rating:	
Between seminar and corridor	STC 40
Between seminar and instructional spaces	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
walls	Reflective
Floor	Absorptive, NRC 25 (minimum)
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

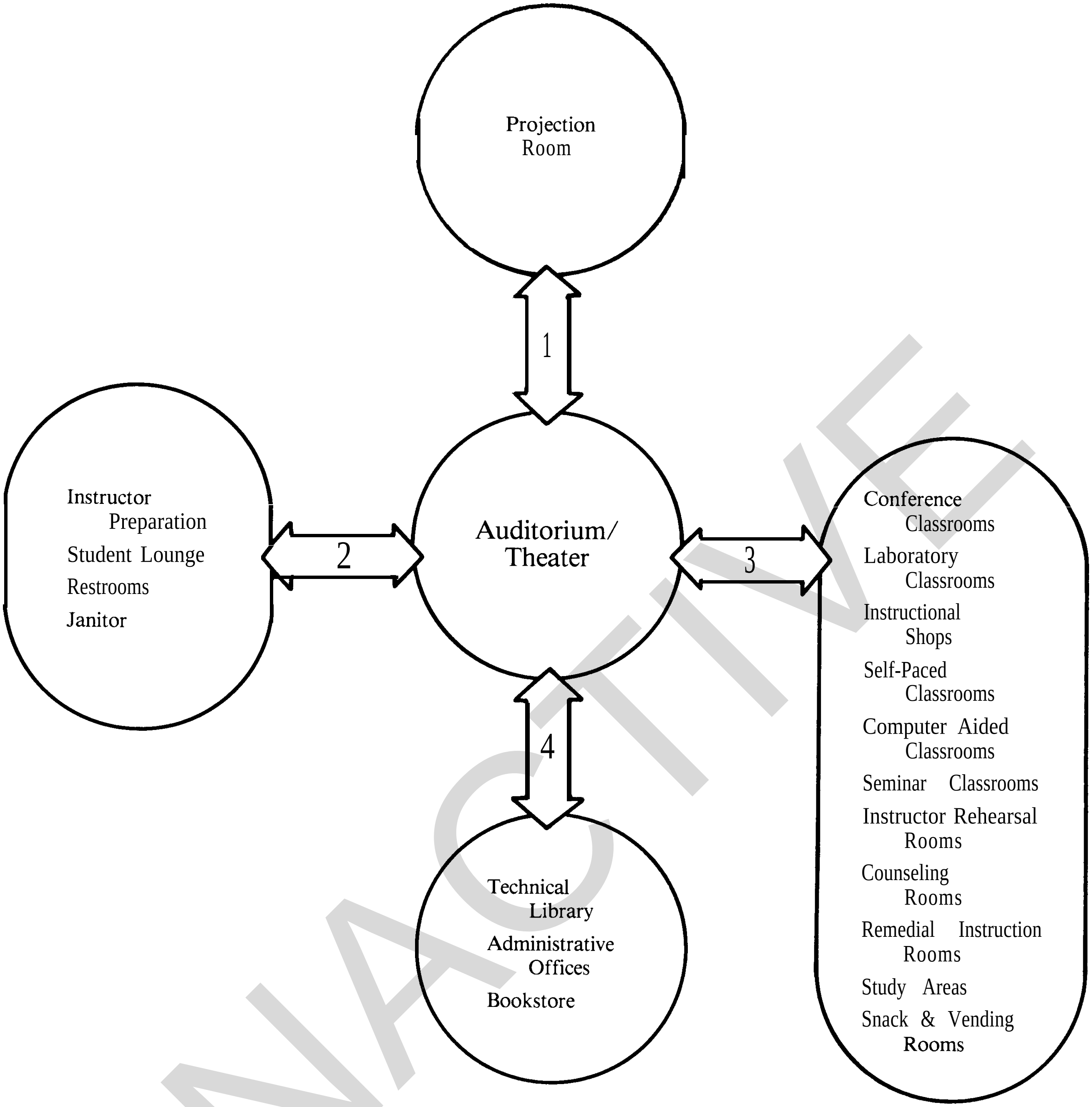


Figure 4-37
Spaces Near Auditoriums and Theaters.

4-8 Auditorium/Theater.

A. Use/Activities.
An auditorium or theater is used to make a presentation to large audiences. Presentations may include the use of A-V media.

B. Occupants.
This type of space usually must accommodate one or more speakers plus an audience (100 people or more), and possibly some technicians or aides (up to three people).

C. Equipment/Supplies.
Equipment usually includes a lectern or table, a screen for A-V materials, microphones, speakers at the front of the room, and special lighting for the speaker platform or stage. The audience may require seats with attached writing surfaces. A special room for projection equipment and audio and lighting controls is usually provided.

D. Access/Circulation.

(1) Location.
See Figure 4-37.

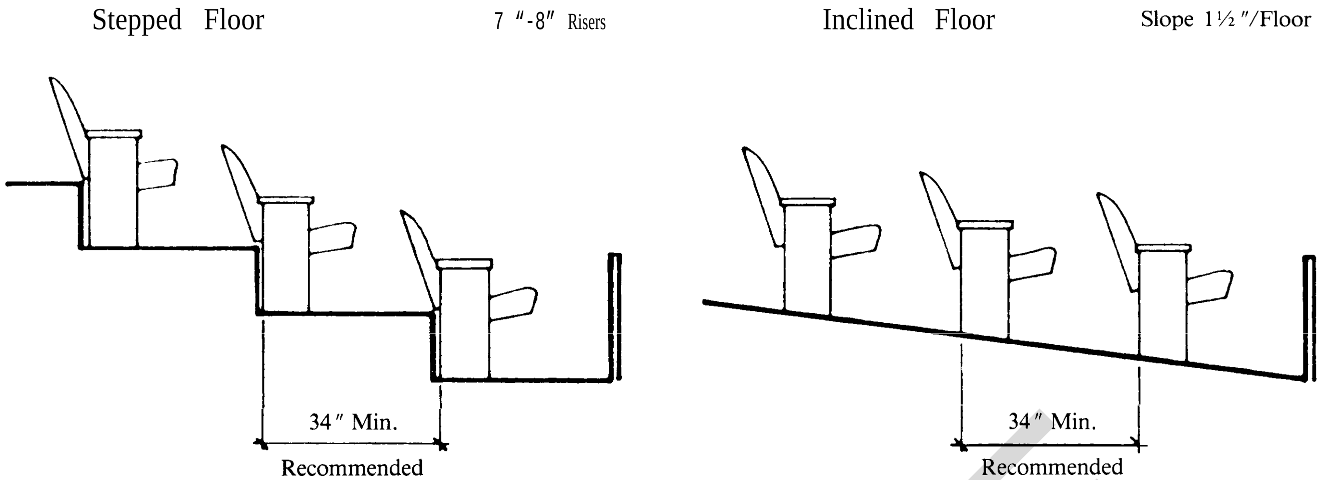
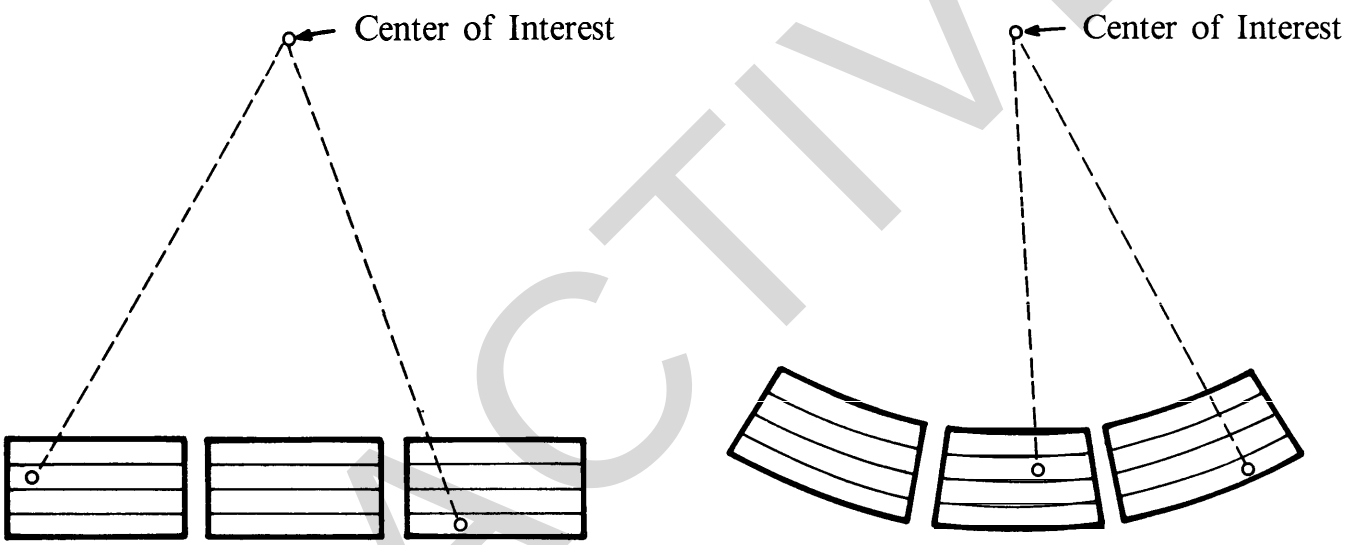


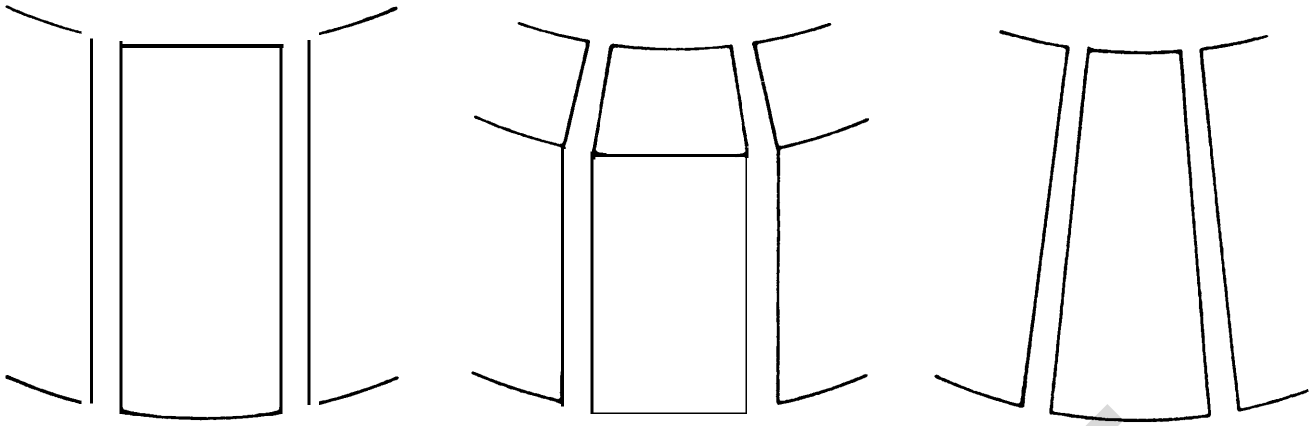
Figure 4-38
Tiered Seating



Straight Rows.
Uncomfortable for individuals seated at sides because the center of interest does not coincide with the natural lines of sight.

Curver Rows.
Most desirable because of comfort and east of vision.

Figure 4-39
Types of Rows.



Straight (least desirable) Compound Fan (most desirable)

Figure 4-40
Typical Three-Bank Layouts.

(2) Circulation Within Room.

a. Instructor platforms that are easy to reach and large enough for the instructor's needs must be available.

b. All seats should have a good view of the speaker and/or screen. Floors may be sloped or tiered. (Figure 4-38). Rows may run straight across the entire theater. Side banks may be canted or entire rows may be curved. Seat construction makes the minimum radius for curved rows 20 feet. The center for radii of rows and center of screens or stage need not coincide, although this is the ideal. When rows are curved, a sloping auditorium floor should be a compound curve or amphitheater type to prevent tilted side seats. Aisles may be straight, curved, parallel, or radial. (Figure 4-39). For best traffic flow, aisles should run at right angles to rows. (Figure 4-40).

c. Requirements for cross aisles vary with the number of seats served and aisle width. Typical rules are that no seat should be more than seven seats away from an aisle and that a minimum aisle width be 3 feet, increasing by varying factors in relation to aisle length. Requirements for cross aisles vary with the number of seats served and aisle width. Rows should not be less than 34 inches apart (seat back to seat back). Seats within each row should not be less than 20 inches on center. Continental seating (in which spaces between rows widen and become aisles) will considerably reduce an auditorium's seating capacity. Aisle widths, number of aisles, seat density, seats in a bank, aisle width, and number of exits and exit locations are specified in local codes and in Life Safety Code 101 of the National Fire Code.

E. Environmental Conditions.
Consideration should be given to the acoustical treatment of auditoriums. In large spaces like auditoriums, a technical expert in sound and acoustics should be consulted to make sure that desired effects are achieved.

F. Furniture.

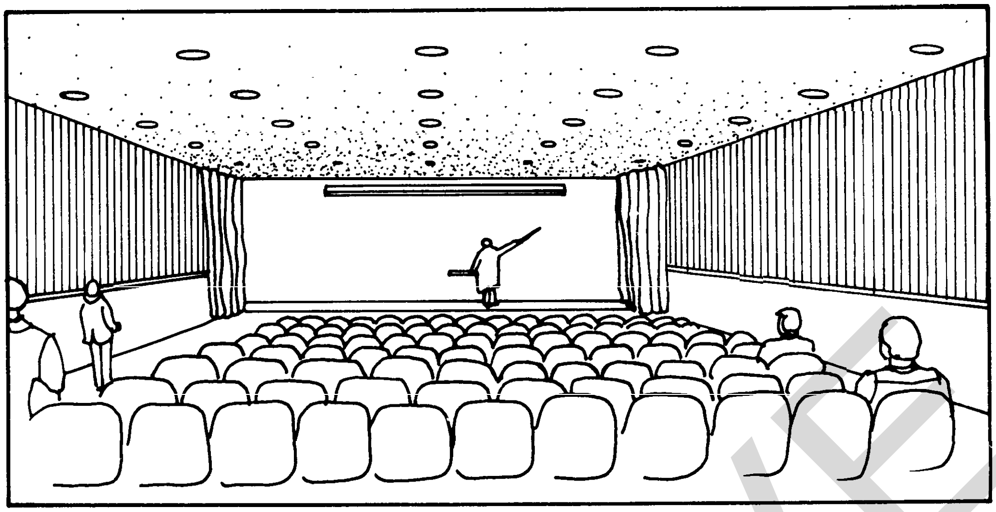
(1) Selection of seats should be based on comfort, cost, size, use, and durability. Each seat should be equipped with a foldaway arm for note-taking. Upholstery variations include spring-edge seats (most luxurious, most expensive); box spring seats (nearly as comfortable as spring-edge seats); spring-back seats; and padded-back seats. Veneer-back seatings are more durable than other types. Upholstered seats give the best acoustical control. Seats are sized based on width; front-to-back depths vary only slightly.

(2) Seat backs which slope backward will require increased spacing between rows.

G. Communication.
Visual aids should be selected based on the need for good visibility by each student. Large classrooms (i.e., those seating several hundred students) should use overhead transparency projectors instead of chalkboards. The installation and use of overhead projectors demand little room preparation. However, the room's ceiling must be high enough to mount a screen large enough for all students to see. Screens are usually mounted about 3 feet from the front wall of the room; the screen bottom is drawn back to the wall to eliminate image keystoning (i.e., to keep the picture square and in focus).

A		B		C		D	
	b	a	b	a			b

Color Scheme



Interior Design Recommendations	
Colors should be muted. Furniture and finishes should be durable for heavy use.	
Room Finishes	
Item	**Recommended Characteristics**
Walls	Vinyl wallpaper is recommended because of its durability and easy maintenance properties.
Floor	Carpet is recommended for aisles only. This application is acoustically sensitive but does not create major maintenance problems.
Trim	Use durable vinyl, hardwood, or metal.
Furniture & Accessories	
Item	**Recommended Characteristics**
Seating	Reference Criteria for Auditorium/Theater Furniture.
Platform	Specific characteristics should be based on local requirements.
Lecturn	Reference Criteria for Classroom Spaces/Conference Classrooms Communication.

Figure 4-41
Interior Design Recommendations for Auditoriums and Theaters.

H. Interior Design.

(1) For recommendations, see Figure 4-41. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-7 lists outline criteria for designing auditoriums and theaters.

Table 4-7 Criteria for Auditoriums and Theaters.

Space Criteria	
Area/Student	7½ s.f./student 35 s.f.
Ceiling Height	10 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Special Characteristics	Student sight lines are critical; depending on the size of the audience and nature of the presentation, platforms for instructors and risers for seating may be required.
Seating Spacing	Reference: NFPA-101
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	30-70%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained) dimming controls for use by instructor
A-V lighting level	30 fc., reference: paragraph 3-4f
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	No
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-9 Instructor Preparation Areas.

A. Use/Activities.
Instructors use these spaces to prepare personal instruction materials and to store current reference materials; they also have sound-controlled typing stations. If the area has good audio or visual privacy, it can also be used for student counseling. Each instructor in this space has an individual work station.

B. Occupants.
Each instructor area will contain one or two instructors, depending on the type of partitioning system.

C. Equipment/Supplies.
Each instructor's work station has a desk and chair, a visitor's chair, and a carrel-type shelf over the desk or a separate storage shelf unit. Typing stations have a typewriter stand or a typing desk and storage space for reference or supply materials.

D. Space Utilization.

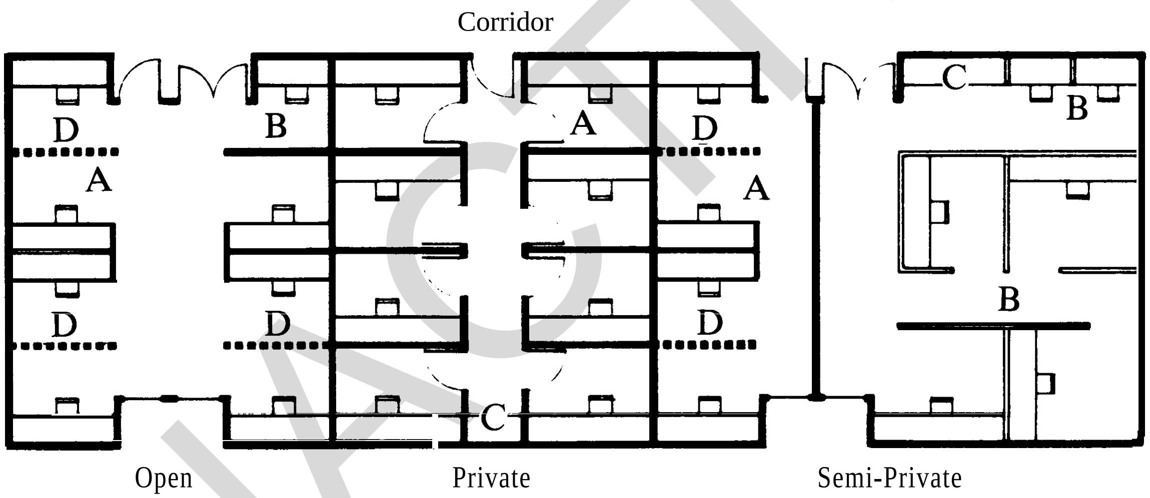
(1) Size.

a. There should be enough space for instructors to prepare their lectures. Each instructor will have 90 square feet.

b. Seventy square feet should be provided for each preparation area, 30 square feet for each typing booth, and 11 square feet for each section of shelving or each storage cabinet.

(2) Shape.
Office space should be based on semi-private (three walls) office planning configurations. (Figure 4-42).

E. Access/Circulation.
Instructor preparation areas should be clustered near classrooms to facilitate joint use of storage and typing facilities and informal intra-staff consultation. (Figure 4-43).



A Instructor Preparation
B Typing Station
C Storage
D Privacy Curtain

Figure 4-42
Instructor Preparation Areas.

F. Furniture.
Instructors need visual and some sound privacy. Typing stations need good sound isolation. The general instructor preparation area should be open, with shoulder-height partitions between each instructor's area. Typing booths should be enclosed with full-height partitions.

G. Interior Design.

(1) For recommendations, see Figure 4-44. For example color schemes called out in the figure, see the Appendix.

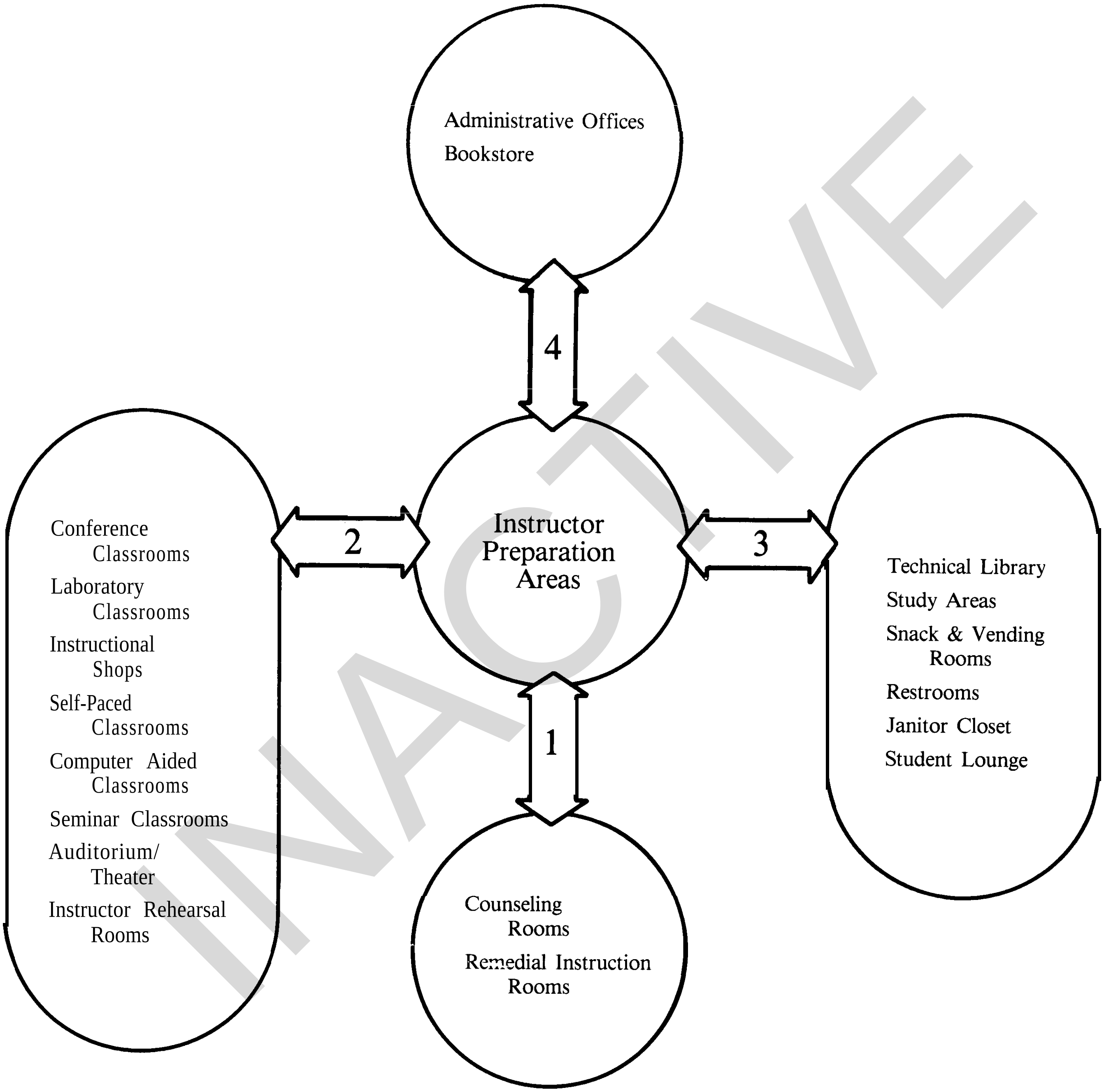
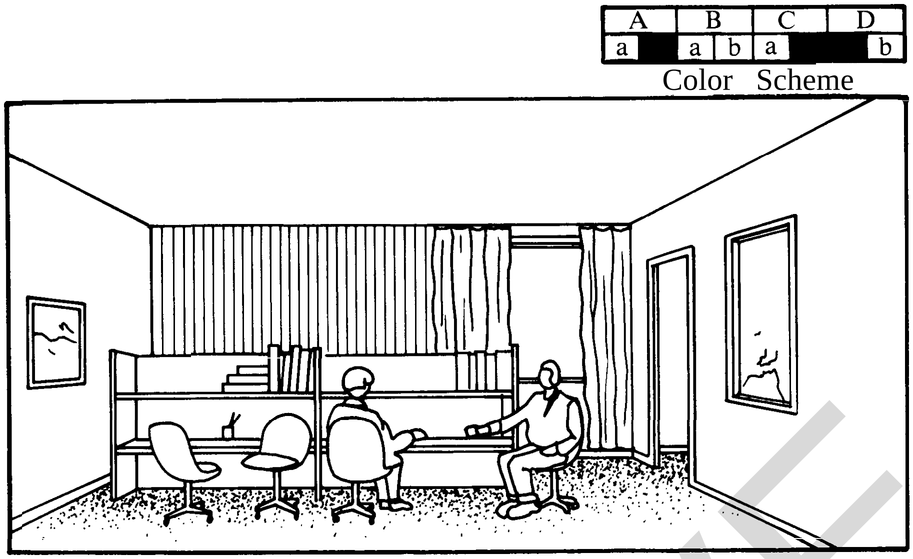


Figure 4-43
Spaces Near Instructor Preparation Areas.



Interior Design Recommendations

The design of Instructor Preparation rooms should allow for instructors to individualize their own areas with personal objects. A neutral color scheme allows each instructor flexibility for personalization.

Room Finishes

Item	Recommended Characteristics
Walls	Use light colors to allow for flexibility. Flat paint is recommended to reduce glare.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	At least one upholstered, swivel chair with casters is recommended per instructor area. One compatible chair is also required for instructor student counseling.
Desk	Desks, partitions, and shelves should all be part of an integrated open office system.
Curtains	Open weave curtains are recommended to limit direct sunlight, Colors should coordinate with the overall color scheme.

Figure 4-44
Interior Design Recommendations for Instructor Preparation Areas.

(2) For general guidance on interior design, see DG 1110-3-122.

H. Criteria.
Table 4-8 lists outline criteria for designing instructor preparation areas.

Table 4-8 Criteria for Instructor Preparation Areas.

Space Criteria	
Area/Student	90 s.f.
Ceiling Height	10 ft.
Floor Loading (minimum)	50 psf, 70 psf with partitions
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	70 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (min.)
Floor	Absorptive, NRC 25 (min.)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-10 Instructor Rehearsal Rooms.

A. Use/Activities.
Instructors use this space to practice a lecture or demonstrations. A small audience may help with or criticize the presentation; lectures are sometimes videotaped. Instructor rehearsal rooms are sometimes also used for student counseling or remedial instruction.

B. Occupants.
This space must accommodate an instructor, a small audience, and equipment operators.

C. Equipment/Supplies.
Typical equipment used in this space may include a lectern or instructor table with A-V controllers; instructor platform; desks or chairs and tables for the audience; A-V equipment (projection screen and microphones, slide, movie, or viewgraph projector; audio and television recording equipment); special lighting and lighting controls; and chalkboards and backboards.

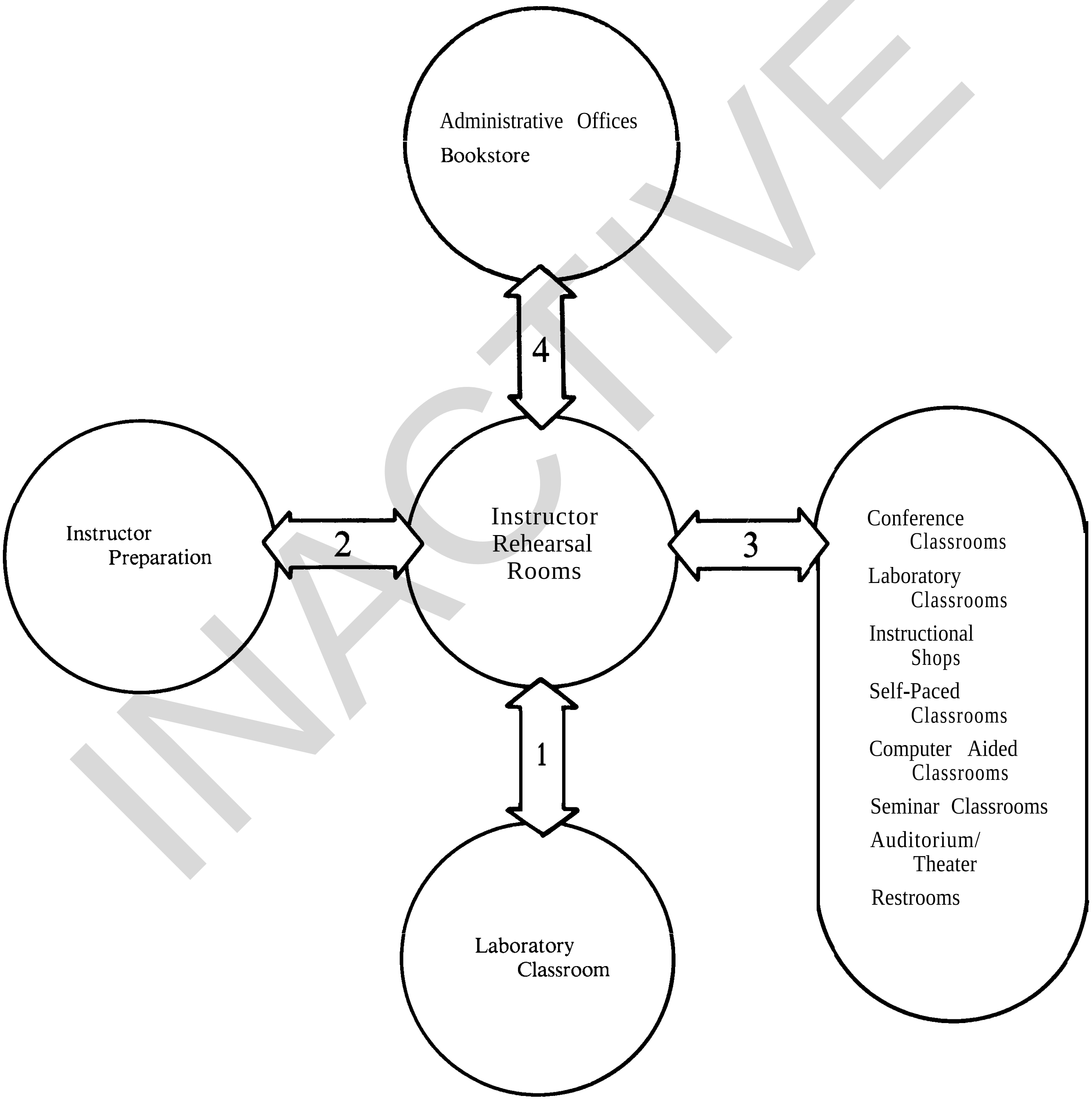


Figure 4-45
Spaces Near Instructor Rehearsal Rooms.

D. Space Utilization.

(1) Size.
The room should be about the same size as a seminar room (paragraph 4-5e above).

(2) Shape.
The room should be about the same shape as a seminar room (paragraph 4-5e above).

E. Access/Circulation.
The room should be located to allow convenient use of the room for seminar classes as required. Primary consideration, however, should be given to a location next to the instructor preparation areas; this will facilitate use and control of the area, as well as provide private counseling space. (Figure 4-45).

F. Environmental Conditions.
Adequate lighting should be provided for A-V materials and practice lectures/demonstrations (paragraph 4-8a above). A separate control should be provided for the platform lighting. The general lighting level will be 50 foot-candles. The A-V lighting level is 30 foot-candles for viewing; 70 foot-candles for black and white videotaping and 250 foot-candels for color videotaping.

G. Furniture.
The rehearsal room should be adequately furnished. All furniture surfaces must be durable and easy to maintain. The rehearsal room should have A-V controls, a projection screen, a blackboard, and 10 to 12 desks. (Figure 4-46). There should be a television cassette unit so taped presentations can be reviewed and to allow monitoring of lectures during taping (paragraph a above).

H. Interior Design.

(1) For recommendations, see Figure 4-47. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-9 lists outline criteria for designing instructor rehearsal rooms.

A Projection Station
B TV Monitor & Recorde
C Projection Screen
D Lectern
E Student Station
F Platform

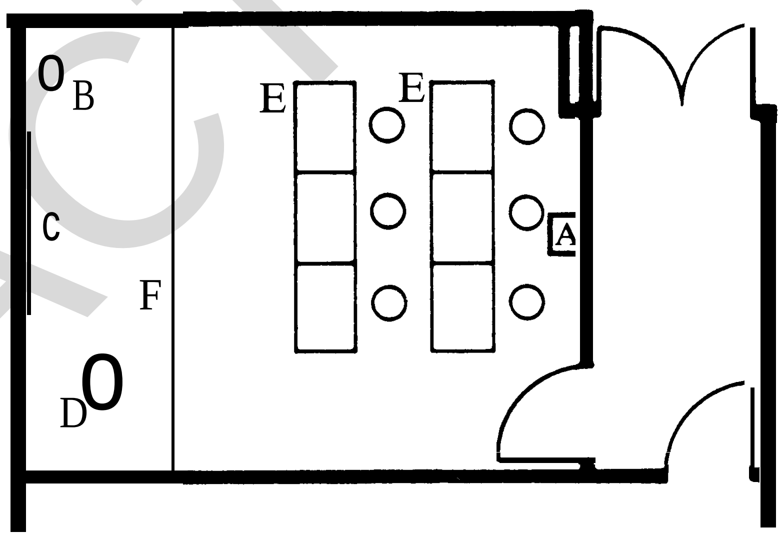
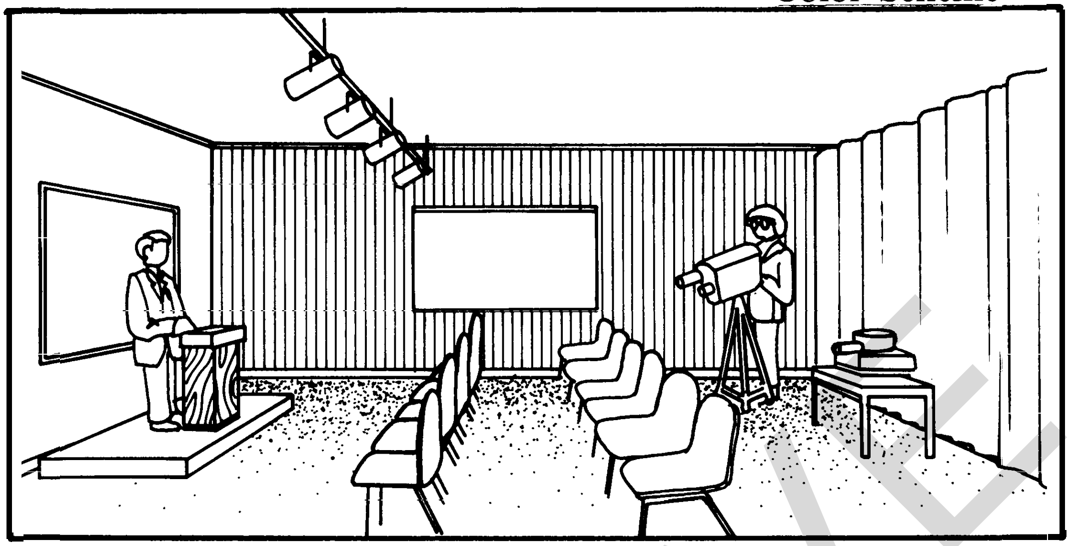


Figure 4-46
Instructor Rehearsal Room.

A		B		C
b	a	b	a	

Color Scheme



Interior Design Recommendations

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint in recommended colors to reduce glare. Coordinate with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Chairs with tablet arms are recommended.
Platform	A small, moveable wood platform is suggested for flexibility.
Curtains	Blackout shades are recommended. Colors should coordinate with the overall color scheme.

Figure 4-47
Interior Design Recommendations for Instructor Rehearsal Rooms.

Table 4-9 Criteria for Instructor Rehearsal Rooms.

Space Criteria	
Area/Student	250-375 s.f.
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
A-V lighting level: Viewing	30 fc. (maintained)
Taping (black & white)	70 fc. (maintained)
Taping (color)	250 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Not required
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110/220 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-11 Counseling Spaces.

A. Use/Activities.

Counseling spaces are areas where instructors meet with individual students to discuss academic problems. Instructor preparation areas, instructor rehearsal rooms, empty classrooms, seminar rooms, or other areas which have audio and visual privacy are used for counseling.

B. Occupants.

Counseling spaces usually must accommodate one instructor and one student.

C. Equipment/Supplies.

This type of space usually requires two chairs of the same height (so an instructor does not intimidate the student by looking down at him or her) and a low, small table.

D. Space Utilization.

There should be enough space for two or three people to sit and talk with a comfortable distance between them. Each counseling room should be about 80 square feet. Ideal dimensions would be 8 by 10 feet or 9 by 9 feet. The ceiling should not be more than 9 feet high.

E. Access/Circulation.

Counseling rooms should be private. Counseling rooms should be near other instructor spaces so that instructors and supervisors can control their use. When possible, counseling rooms should be separate, with walls and a closable door, not partitioned spaces. (Figure 4-48).

F. Environmental Conditions.

(1) Windows.

Counseling spaces should not give a feeling of claustrophobia. Although the counseling space should be private, it may have windows in one wall to create a more spacious feeling. Windows on an interior wall should open onto a little-used circulation path, not onto an area where people are sitting. Furniture should be arranged so that neither the instructor's nor the student's back faces the windows.

(2) Sound.

Counseling spaces should be private. Walls and doors of the counseling space should be soundproofed well enough so confidential discussions are not overheard. If the counseling room is along a circulation path, the room should be acoustically treated so outside noises do not disturb or distract the instructor and student.

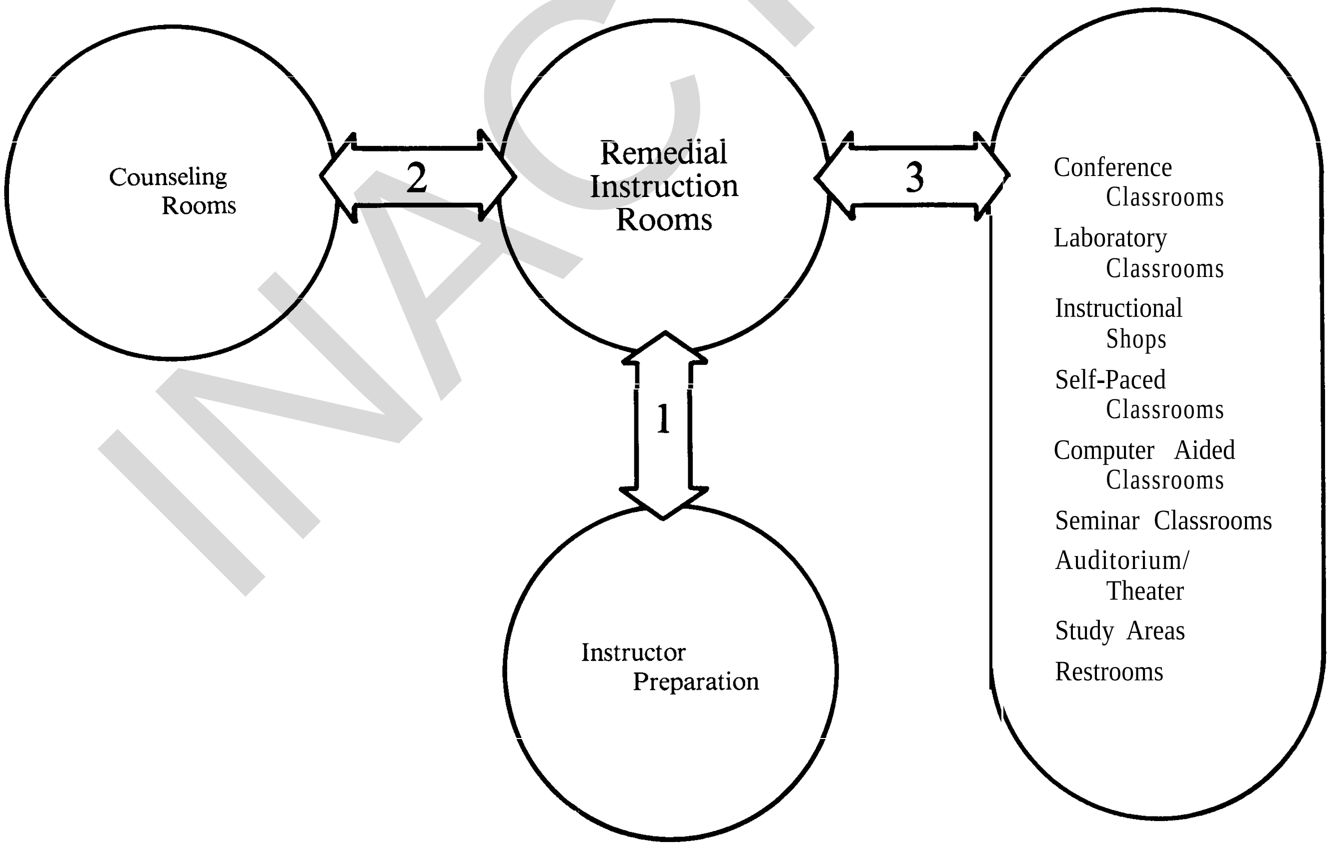
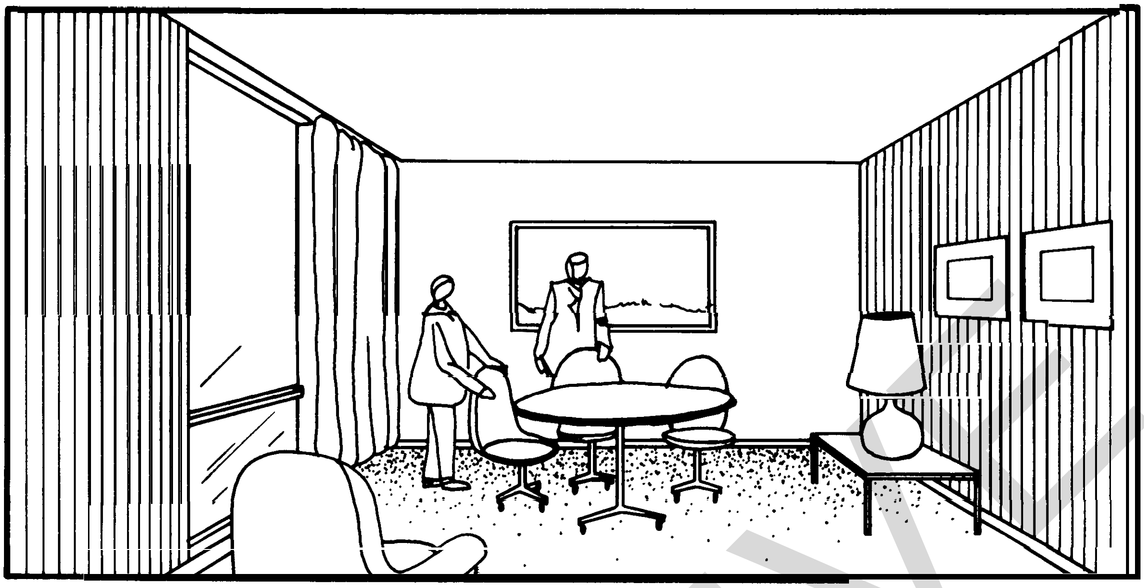


Figure 4-48
Spaces Near Counseling Spaces.

A				C		D	
a	b			a	b		b

Color Scheme



Interior Design Recommendations	
Room Finishes	
Item	**Recommended Characteristics**
Floor	Use recommended carpeting to help create a comfortable quiet space
Furniture & Accessories	
Item	**Recommended Characteristics**
Seating	Chairs should be comfortable but without swivel mechanism.
Table	A small round conference table in recommended wood finish is appropriate.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-49
Interior Design Recommendations for Counseling Spaces.

G. Interior Design.

(1) The general character of counseling spaces should be informal.

(2) **Recommendations.**

a. For recommendations, see Figure 4-49. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

H. Criteria.
Table 4-10 lists outline criteria for designing counseling spaces.

Table 4-10 Criteria for Counseling Spaces.

Space Criteria	
Area	80 s.f.
Ceiling Height	9 ft.
Floor Loading	50 psf, 70 psf with partitions (minimum)
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35070 (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	70 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 v
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-12 Remedial Instruction Spaces.

A. Use/Activities.
Based on a student's performance in class or on information obtained during academic counseling, an instructor may decide that a student needs remedial help. This usually involves supervised study or a review of troublesome material in a one-on-one setting. Remedial instruction may take place in the instructor preparation area (if there is a place for a student to sit undisturbed in the instructor's view) or in empty classrooms, instructor rehearsal rooms, or seminar classrooms.

B. Occupants.
Remedial work spaces usually accommodate one instructor and one student. Supervised study areas usually accommodate one instructor and as many as three or four students.

C. Equipment/Supplies.
Remedial instruction spaces usually have a desk or table and chair for each student, and an instructor's work station. Work stations should be placed so the instructor can do his/her own work while supervising the student.

D. Space Utilization.
Remedial instruction spaces should be large enough to accommodate one instructor and a maximum of three or four students. Each remedial instruction area should be 100 square feet.

E. Access/Circulation.
See Figure 4-50.

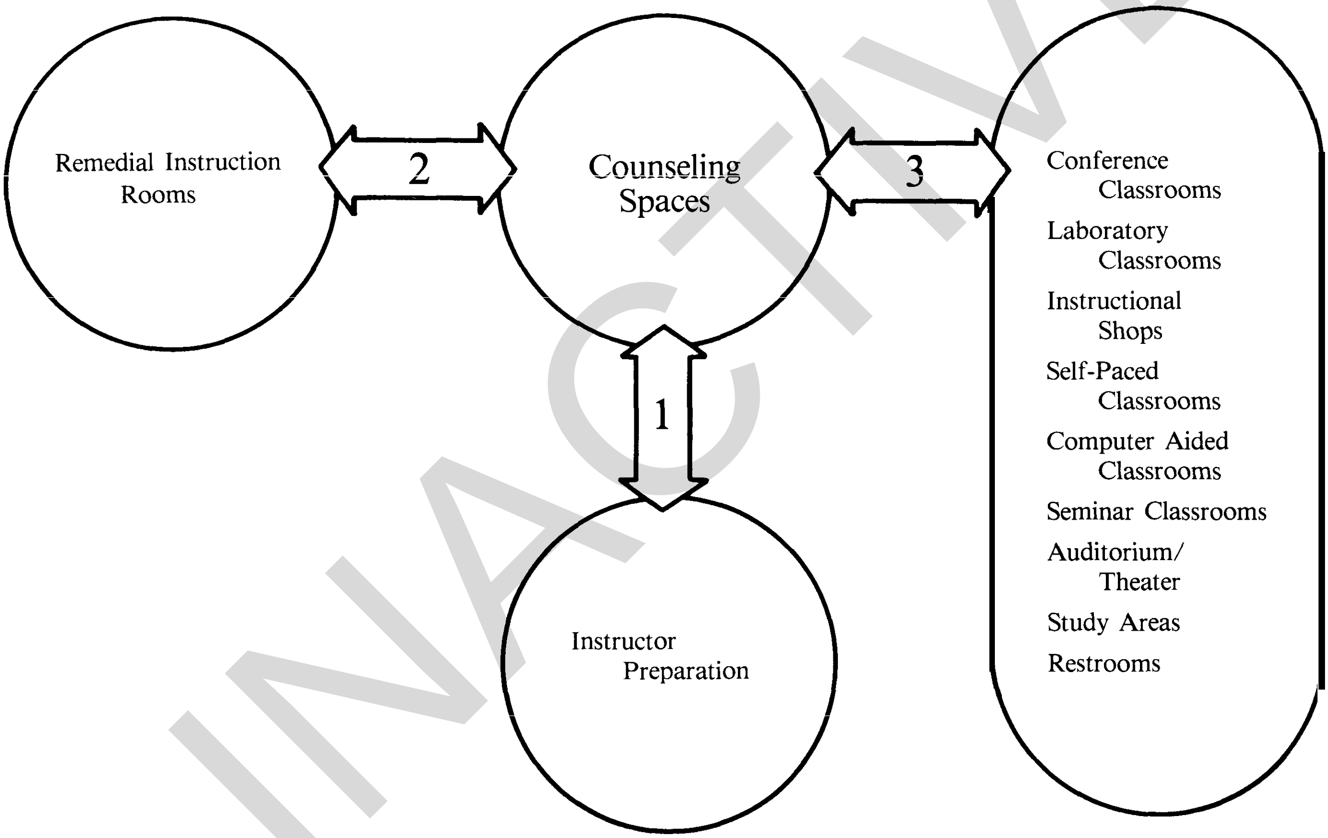


Figure 4-50
Spaces Near Remedial Instruction Spaces.

F. Environmental Conditions.
Occupants should not feel closed in. Windows help create a more spacious feeling, especially in small rooms.

G. Criteria.
Table 4-11 lists outline criteria for designing remedial instruction spaces.

Table 4-11 Criteria for Remedial Instruction Spaces.

Space Criteria	
Area/Room	100 s.f.
Ceiling Height	9 ft.
Floor Loading	50 psf, 70 psf with partitions (minimum)
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-13 Technical Library.

A. Use/Activities.

(1) A typical service school technical library provides topical references oriented to the school's field of instruction. The library's function is similar to that of a departmental library in a large university. It provides reference materials for administrative personnel and instructors and, to a lesser extent, students.

(2) Library users borrow and return reference materials, browse through the stacks or film holdings, check catalog files, etc. The library staff acquires, catalogs, files, checks out and receives materials, and helps users locate references.

(3) The instructional program provides most student reference material. The technical library is independent of other post libraries and, as a rule, is not available to nonschool personnel.

B. Occupants.
This space usually accommodate one librarian, several library aides, and many users. The number of users in the library at one time depends on the school's size and the time of day.

C. Equipment/Supplies.
The library usually has stack and storage areas with shelving or microfiche files; drawer files for reference materials; work stations with equipment for users to view films or read reference materials or to write while working from references; catalog files and index displays; checkout and return areas; and staff areas with equipment for ordering, cataloging, and processing new materials. See Chapter 8 of DG 1110-3-110 for guidance on technical libraries.

D. Space Utilization.
There should be enough library space. Reading areas and the circulation desks, including traffic, require 25 square feet per person reading. Space required for classified storage vaults and reading rooms is determined on a case-by-case basis. The number of work stations or carrels used for microfiche, microfilm, or other A-V media is based on each library's needs. Typically, stack areas are sized so there is 1 square foot of floor area for every 15 books. This rule includes aisles between bookshelves and assumes stacks are six to seven shelves high. For more detailed instructions for programming library space, refer to DG 1110-3-110, Chapters 2 and 3.

E. Access/Circulation.

(1) Location.
Location of the technical library should provide ready access for organizational elements which use it most. These are administrative personnel (especially those associated with combat, doctrine, and training developments) and instructional staff. The library must also be located so as not to interfere with expansion plans for other school facilities and so that it can be expanded with minimal disruption of library operations. (Figure 4-51).

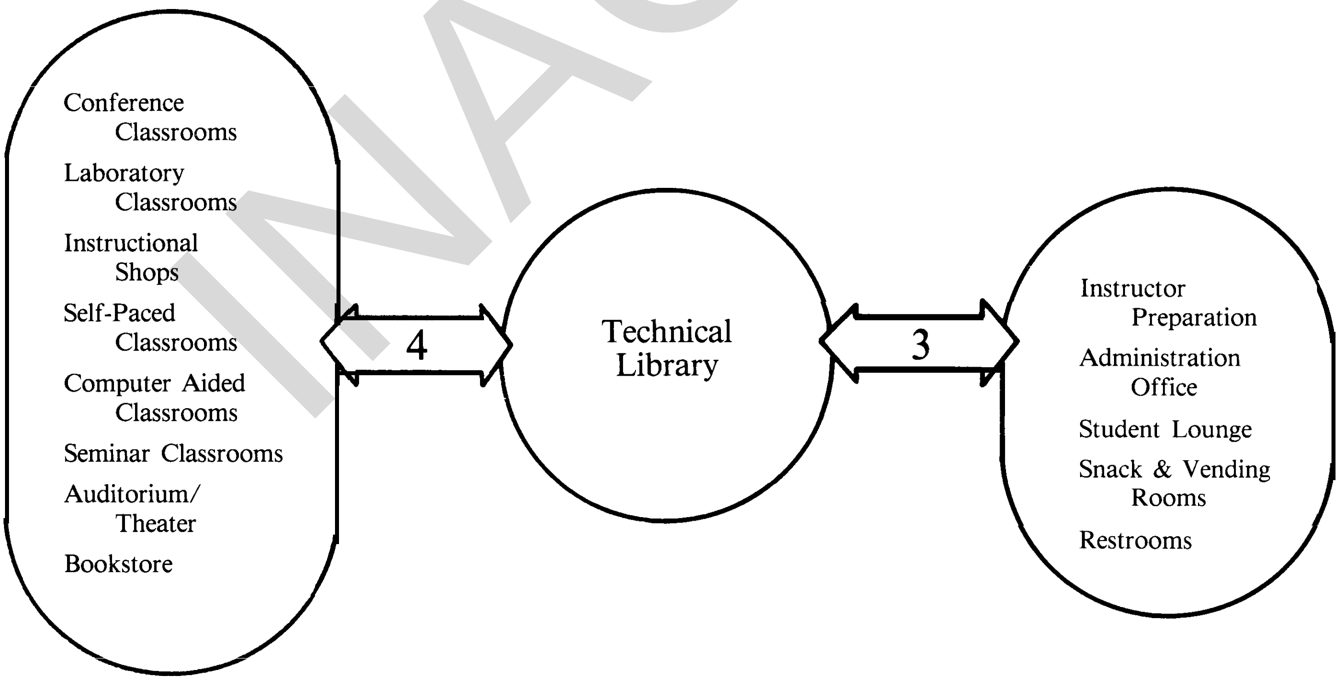


Figure 4-51
Spaces Near the Technical Library.

(2) Circulation Within Room.
Stack aisles should be large enough to allow materials to be viewed easily. The recommendation face-to-face spacing between book stacks is 3 feet.

F. Environmental Conditions.

(1) Lighting.

a. Different kinds of lighting should be used throughout the library to satisfy different visual task requirements. Specially designed lighting systems should be used in the stack, carrel, and reading areas and at the circulation desk. A lighting designer or engineer should recommend proper lighting systems during the design phase.

b. The general required lighting level is 50 foot-candles.

(2) Storage.
There should be enough storage to accommodate both existing and future learning resources. (Figure 4-52).

G. Furniture.
Library furniture should be attractive and comfortable. If the library is supervised, there is less chance that students will abuse the furniture. Therefore, couches and cushioned chairs can be used in specified reading areas.

H. Interior Design.

(1) For recommendations, see Figure 4-53. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-2 lists outline criteria for designing a technical library.

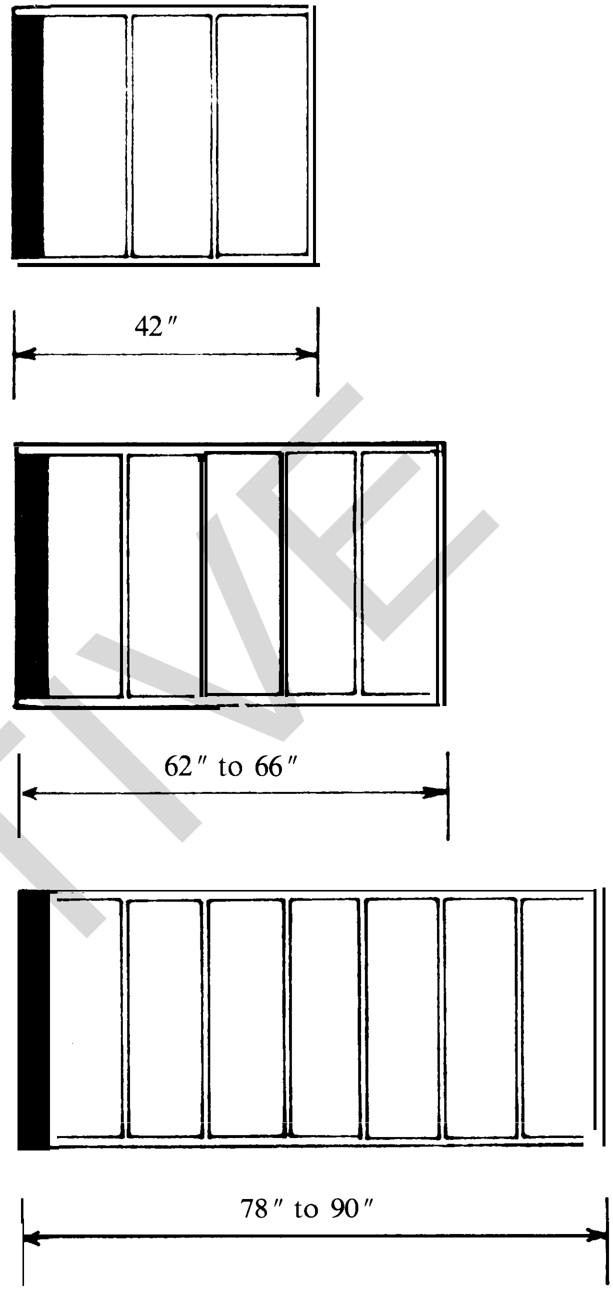
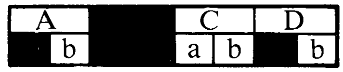
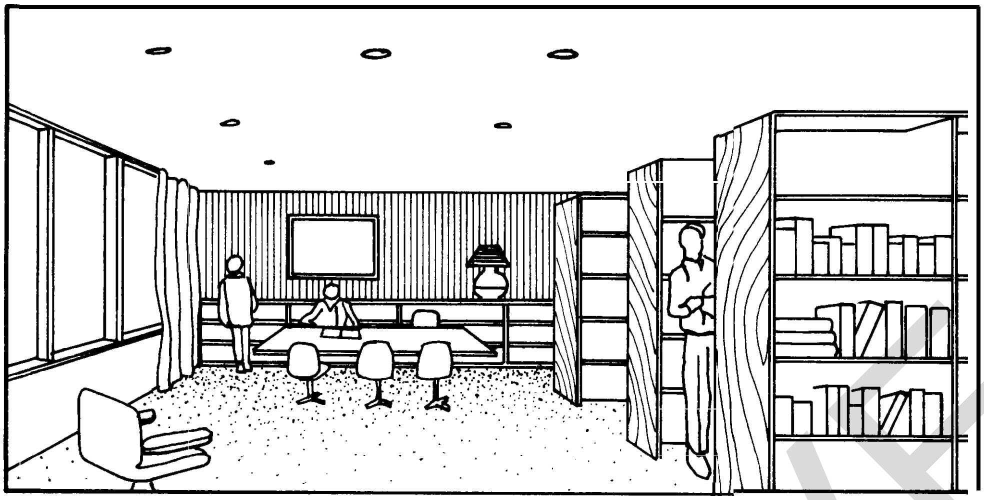


Figure 4-52
Typical Heights for 3-Foot-Wide Storage Units.



Color Scheme



Interior Design Recommendations

Muted colors help to minimize distractions.
There should be a variety of furniture types to allow different modes of study.

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint in recommended colors.
Floor	Use recommended carpeting.

Furniture & Accessories

Item	Recommended Characteristics
Seating	A mixture of comfortable table seating and lounge chairs is recommended.
Tables	Plastic laminate is recommended.
Carrels	Plastic laminate is recommended.
Bookcase	Finish should match doors and trim as appropriate.
Desk	The service desk should be compatible with overall design and finish.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-53
Interior Design Recommendations for a Technical Library.

Table 4-12 Criteria for a Technical Library.

Space Criteria	
Area	preference: paragraph 3-5
Ceiling Height	8 ft. for stacks
Floor Loading	125 psf
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating	STC 45
Sound reflectance: Ceiling	Absorptive
Floor	Absorptive
Service Criteria	
Electrical	
Power	110/120 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Special Criteria	
Security Vault (as required)	See DG 1110-3-110, Chapter 12

4-14 Study Areas.

A. Use/Activities.
Students use this type of space to do independent reading and writing.

B. Occupants.
The number of students a study area must accommodate depends on a school's curriculum and training methods.

C. **Equipment/Supplies.**
Study areas typically have a comfortable chair (for reading), desks or tables and chairs, and properly equipped carrels (for self-paced lessons). Specially designed study areas may be needed if students must practice using special equipment.

D. Space Utilization.
Size. Study areas should be large enough to meet most needs. Each study area should provide 30 square feet per student (including circulation). The number of students to be accommodated at one time will vary by school.

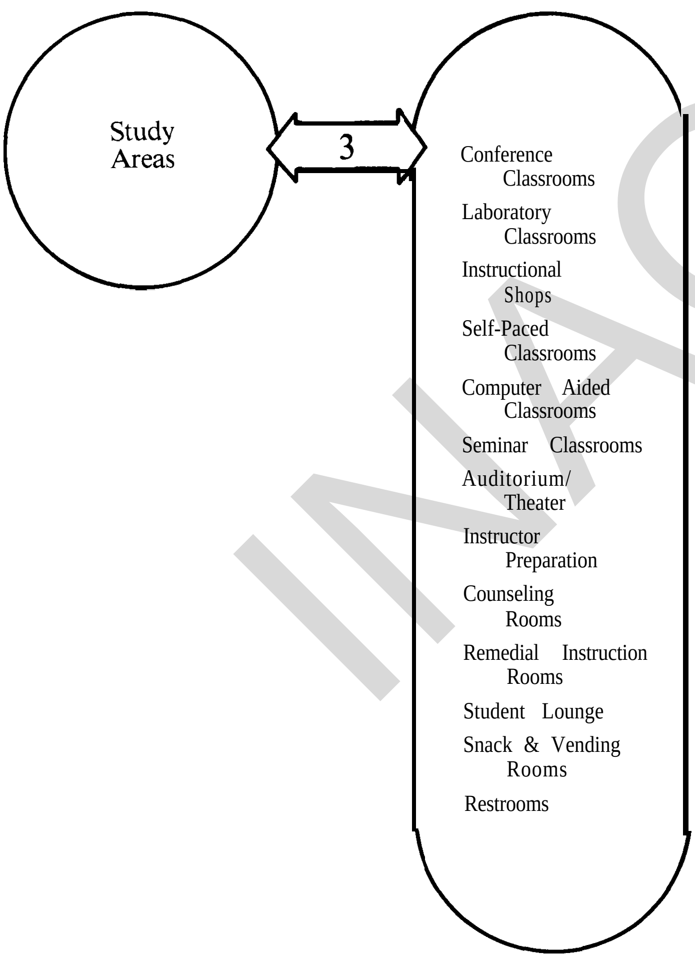


Figure 4-54
Spaces Near Study Areas.

E. Access/Circulation.
See Figure 4-54.

F. Furniture.
Each space should be analyzed to see if special types of furniture are needed. Carrels are needed for viewing self-paced lessons and should be used when students must be free from visual distractions. Carrels, tables, and chairs are needed when students must do written work.

G. Interior Design.

(1) For recommendations, see Figure 4-55. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

H. Criteria.
Table 4-13 lists outline criteria for designing study areas.

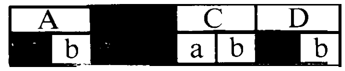
4-15 Projection Rooms.

A. Use/Activities.
This space is used to operate rear-screen projection equipment and to store projection materials. Rear-screen projection rooms which extend into a corner of a classroom can be operated from the instructor's area. Mirrors are used to project the image on a screen, or projectors can be placed in a separate room located behind the screen. Larger projection rooms may have areas for preparing visual programs and/or maintaining equipment.

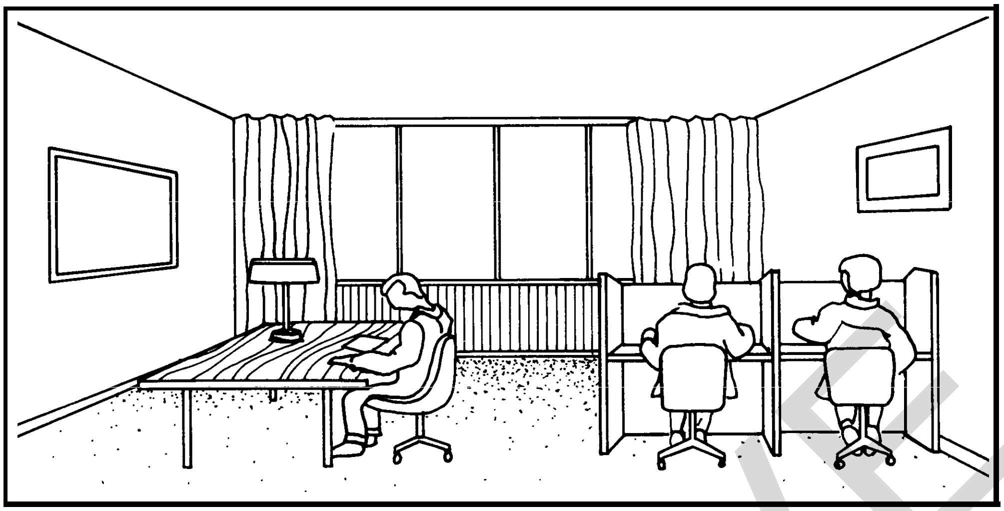
B. Occupants.
Large projection rooms (or projection rooms supporting more than one instructional space) that have a rear-projection screen require space for a projectionist or technician. Depending on the design, instructors may be able to operate projectors themselves or by remote control.

C. Equipment/Supplies.
Projection rooms typically have a slide or movie projector, some storage shelves (which are out of the image path), amplifiers and controls for audio equipment, and lighting controls.

D. Space Utilization.
A projection room or booth should permit displayed images to be large enough to be seen without distortion. Since a rear-screen projector must be at a



Color Scheme



Interior Design Recommendations

Muted colors help to minimize distractions. There should be a variety of furniture types to allow for different modes of study.

Room Finishes

Item	Recommended Characteristics
Floor	Use recommended carpeting.
Walls	Use flat paint in recommended colors.

Furniture & Accessories

Item	Recommended Characteristics
Tables	Plastic laminate is recommended.
Seating	A mixture of comfortable table seating and lounge chairs is recommended.
Carrels	Plastic laminate is recommended.
Lighting	Lighting should be carefully designed to fully meet the task requirements of this room. A professional should be consulted.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-55
Interior Design Recommendations for Study Areas.

Table 4-13 Criteria for Study Areas.

Space Criteria	
Area	90 s.f.
Ceiling Height	10 ft.
Floor Loading	50 psf, 70 psf with partitions (minimum)
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Task lighting level	50 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between preparation spaces and corridors	STC 40
Between preparation spaces and classrooms	STC 45
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

distance 1.5 times the screen width, the minimum size for a projector room with an 8-foot-wide screen is about 15 feet deep and 10 feet wide.

E. Access/Circulation.

(1.) Access to Space.
The rear-screen projection room should be easily accessible to the instructor. There should be a 3-foot-wide, solid, opaque door between the projection room and the classroom. It is also advisable to have a door which opens into the projection room from an adjoining hallway.

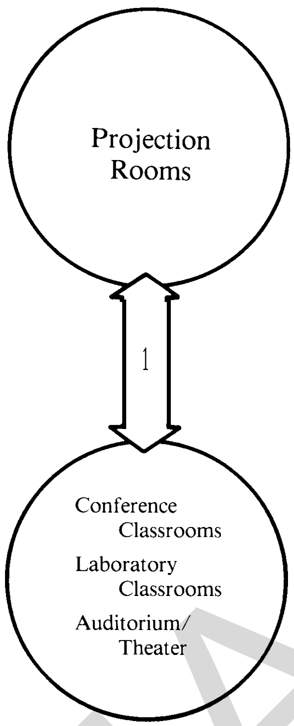


Figure 4-56
Spaces Near Projection Rooms.

(2) Location.
Whenever possible, the rear-screen projection room should serve more than one classroom. (Figure 4-56).

F. Criteria.
Table 4-14 lists outline criteria for designing projection rooms.

4-16 Administrative Offices.

A. Use/Activities.
Service school administrative spaces include the offices of the Commandant, his/her staff, his/her deputies for Combat and Training Development and Training and Education, and the administrative elements of resident instructional departments. (For the specific functions of these organizational elements, see DA PAM 570-558.) Administrative areas typically require private and semi-private offices, clerical spaces, conference rooms, security vaults, and storage areas. These needs may be satisfied by open space planning or conventional office planning.

B. Occupants.
The number of persons an office space may have to accommodate will vary with its function.

C. Equipment/Supplies.
Furniture and equipment needs very widely across organizations. Typical office furniture may meet the needs of many; however, some organizations may need drafting tables, work benches, counters, service windows, or other highly specialized equipment.

D. Space Utilization.

(1) Size.

a. Office space should be based on each occupant's functional needs. Each office space should provide between 80 and 400 square feet per person. Each clerical space should provide between 45 and 90 square feet per person. DG 1110-3-104 provides detailed guidance for planning administrative and office spaces.

Table 4-14 Criteria for Projection Rooms.

Space Criteria	
Area	150 s.f.
Ceiling Height	8 ft.
Floor Loading	50 psf
Environmental	
Thermal	
Temperature, maintained operation	68ºF. (heating), 78ºF. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Acoustic	
Enclosing sound wall rating: Between projection and class	STC 45
Electrical	
Power	110/120 V

b. Ceiling heights should be appropriate. The ceiling heights for closed offices should be a minimum of 8 feet. Open-plan offices should have ceilings at least 9 feet high.

(2) Open Space Planning.
Offices with much personnel interaction should be organized with a minimum of spatial structuring. (Figure 4-57). Activities such as concept study groups can arrange office furniture and low-height partitions to suit a specific project's organizational requirements; when these projects are done and new requirements arise, the office space can be rearranged. Only a few private offices are provided for personnel whose duties require some isolation from group activities.

(3) Conventional Office Planning.
Offices can also be planned as relatively permanent organizational structures. (Figure 4-58). The floor area, degree of isolation, and location of these offices is based on functional relationships among the occupants. The basic assumption in this type of office planning is that such relationships can be clearly determined and are relatively stable.

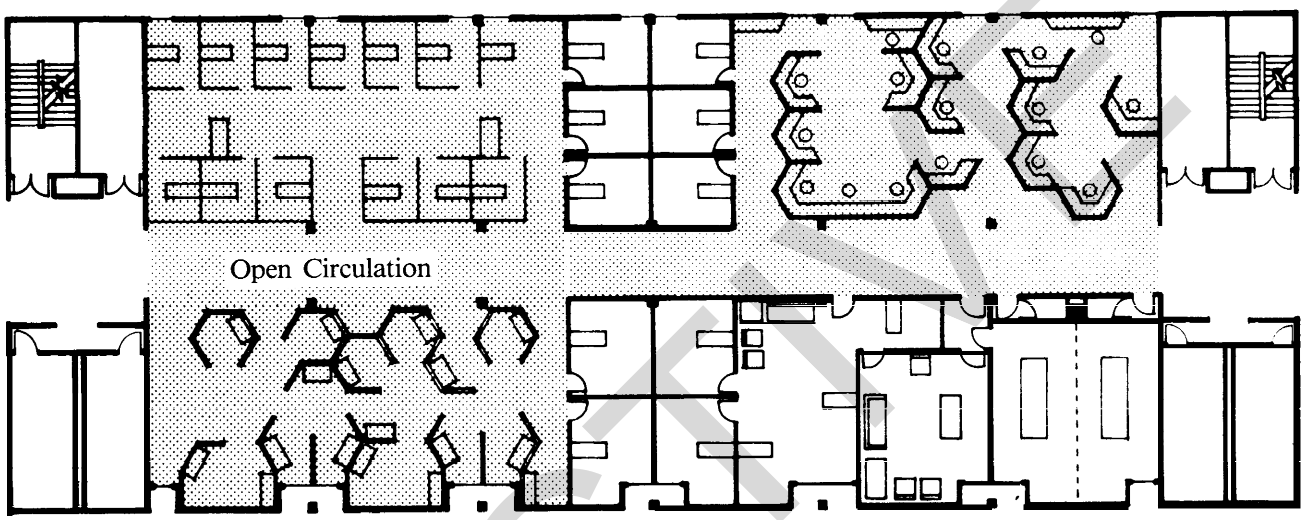


Figure 4-57
Open Office Space Planning.

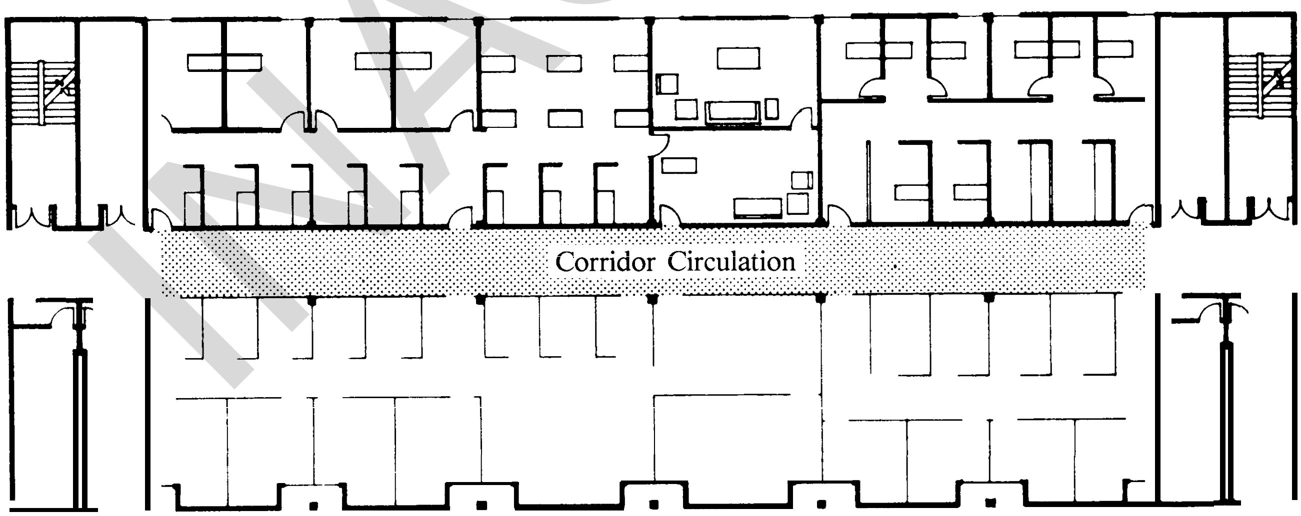


Figure 4-58
Conventional Office Space Planning.

E. Access/Circulation.
See Figure 4-59 and paragraph 5-2 below.

F. Environmental Conditions.
An outside view is essential. Research has shown that most people want an outside view. However, windows should be located to minimize glare and maximize energy conservation. They should provide a northern or southern exposure. With southern exposure, there should be some control of direct sunlight (such as by louvered blinds or curtains).

G. Storage.
Space-saving shelving should be used to conserve floor space. A free-standing shelf unit, if used, should contain three to six shelves before other units are added. Shelving which can be wall-hung, set on desks, or hung on partitions will better use floor space.

H. Interior Design.

(1) For recommendations, see Figure 4-60. For example color schemes called out in the figure, see the Appendix.

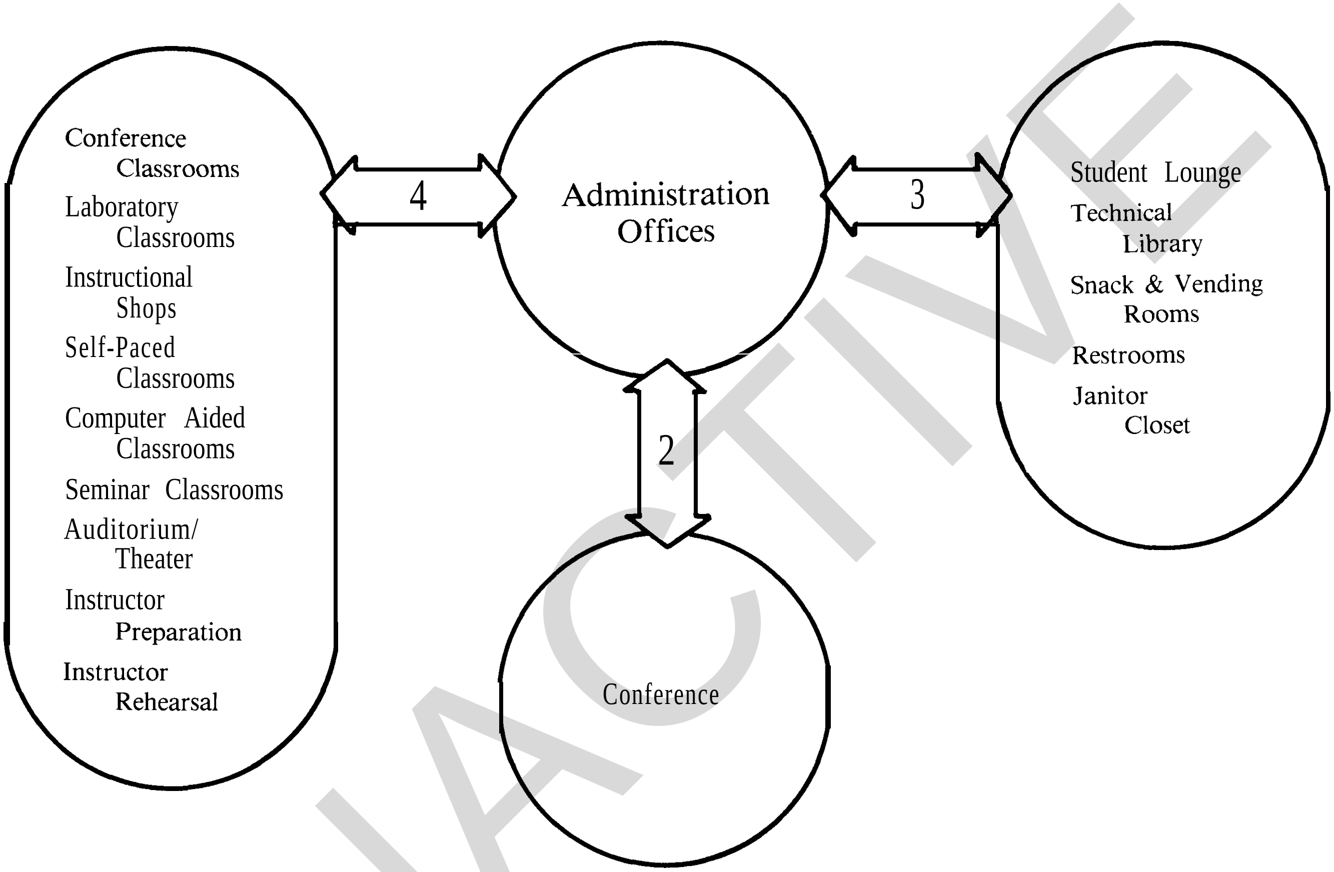
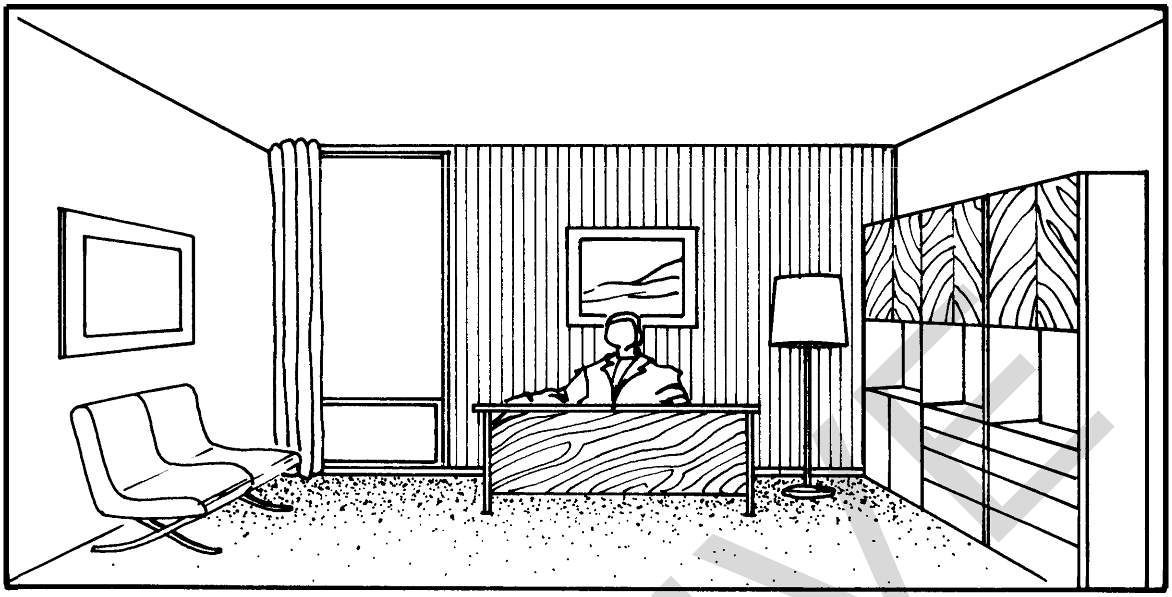


Figure 4-59
Spaces Near Administrative Offices.

[redacted]		B		C		D	
[redacted]		a	b	a	[redacted]		b

Color Scheme



Interior Design Recommendations

Muted colors help to minimize distractions. There should be a variety of furniture types to allow different modes of study.

Room Finishes

Item	Recommended Characteristics
Floor	Use recommended carpeting.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Comfortable swivel chairs with casters are recommended.
Curtains	Open weave curtains are recommended to limit direct sunlight.

Figure 4-60
Interior Design Recommendations for Administrative Offices.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-15 lists outline criteria for designing administrative offices.

Table 4-15 Criteria for Administrative Offices.

Space Criteria	
Areas	Reference: TM 5-800-1, Administrative Facilities
Offices	80-400 s.f ./person
Clerical Space	45-90 s.f ./person
Floor Loading	Reference: TM 5-800-1, Structural Design
Ceiling Heights	
Enclosed offices	8 ft. minimum
Open plan offices and clerical spaces	9 ft. minimum
Environmental	
Thermal	
Temperature, maintained operation	68ºF. (heating), 78ºF. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	80-90%
Walls	40-60%
Floor	20-40%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	STC 40
Sound reflectance: Ceiling	Absorptive, NRC 50 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

4-17 Administrative Conference Rooms.

A. Use/Activities.
This space is used for meetings, discussions, and presentations. Conference rooms are not used for academic courses. They mainly provide meeting spaces for school organizations which do not involve student instruction.

B. Occupants.
Conference rooms may have to accommodate from six to 25 people at one table. A conference classroom is more appropriate for presentations to larger groups.

C. Equipment/Supplies.
Conference rooms used for meetings and discussions may require one or more tables with chairs. Audio-visual and wall-mounted graphics or chalkboards may also be needed for presentations. A lectern may be desirable.

D. Access/Circulation.
See Figure 4-61.

E. Environmental Conditions.
There should be adequate lighting for each task. The required general lighting level is 50 foot-candles. The A-V lighting level is 30 foot-candles.

F. Interior Design.

(1) For recommendations, see Figure 4-62. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

G. Criteria.
Table 4-16 lists outline criteria for designing administrative conference rooms.

4-18 Student Lounges.

A. Use/Activities.
These spaces are used for visiting, smoking, and relaxing. Some are adjacent or integral to vending machines or short-order snack bars.

B. Occupants.
The number of occupants will vary. Peak occupancy will be between class periods, at lunch time, or during an unscheduled class period.

C. Equipment/Supplies.
Typical lounges have comfortable, informal seating, tables with chairs, and ashtrays.

D. Space Utilization.
Lounges should be large enough to insure comfort and relaxation. There will be 0.1 square foot of lounge space for each square foot of instructional space. Lounge seating will provide 30 square feet per person; lounge standing space will be 6 square feet per person. Ceilings must be at least 9 feet high.

E. Access/Circulation.

(1) Location.
Lounges should be separated from classrooms and laboratories. Student lounges must be located where they do not interfere with teaching. Student lounges should be near latrine and vending areas, but separated from functional areas to allow acoustical isolation. (Figure 4-63 and paragraph 5-2 below).

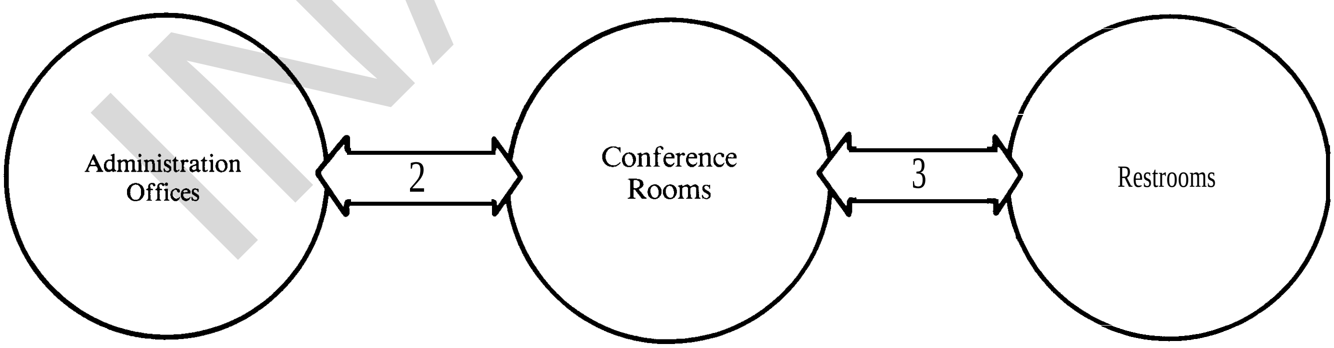
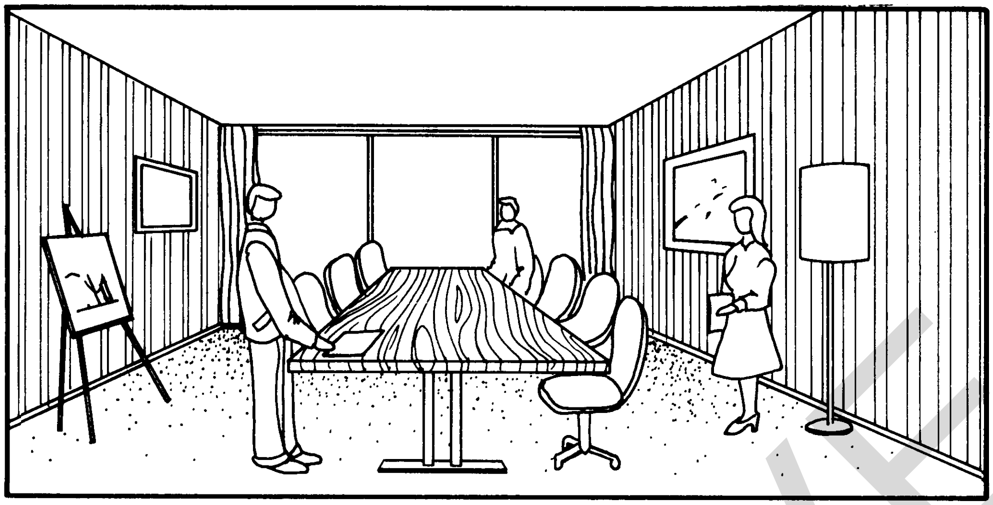


Figure 4-61
Spaces Near Administrative Conference Rooms.

	B		C		D	
	a	b	a			b

Color Scheme



Interior Design Recommendations

Design scheme of conference rooms should present a distinguished military appearance.

Room Finishes

Item	Recommended Characteristics
Walls	Use flat paint in recommended colors, wallpaper or paneling coordinated with the overall interior design scheme.
Floor	Use recommended carpeting.
Doors	Use recommended accent colors or wood finishes.
Trim	Use recommended accent colors or wood finishes.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Comfortable, upholstered chairs on casters should be provided.
Tables	Use laminated plastic or wood veneer.
Curtains	Open weave curtains are recommended to limit direct sunlight. Blackout shades may also be necessary.

Figure 4-62
Interior Design Recommendations for Administrative Conference Rooms.

Table 4-16 Criteria for Administrative Conference Rooms.

Space Criteria	
Area/Person	20 s.f./person
Ceiling Height	10 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Special Characteristics	Student sight lines are critical; depending on the size of audience and nature of the presentation, platforms for instructors and risers for seating may be required.
Seating Spacing	Reference: NFPA-101
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Positive
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
A-V lighting level	30 fc., reference: paragraph 3-4f
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Surface reflectance: Ceiling	70-90%
Walls	40-60%
Floor	30-50%
Daylighting	Yes
Window orientation	North or south
Acoustic	
Enclosing sound wall rating:	
Between instructional spaces	STC 45
Between instructional spaces and corridors	STC 40
Sound reflectance: Ceiling	Reflective
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Telephone/intercom clock control as programmed
Adaptability	Reference: paragraph 3-2g

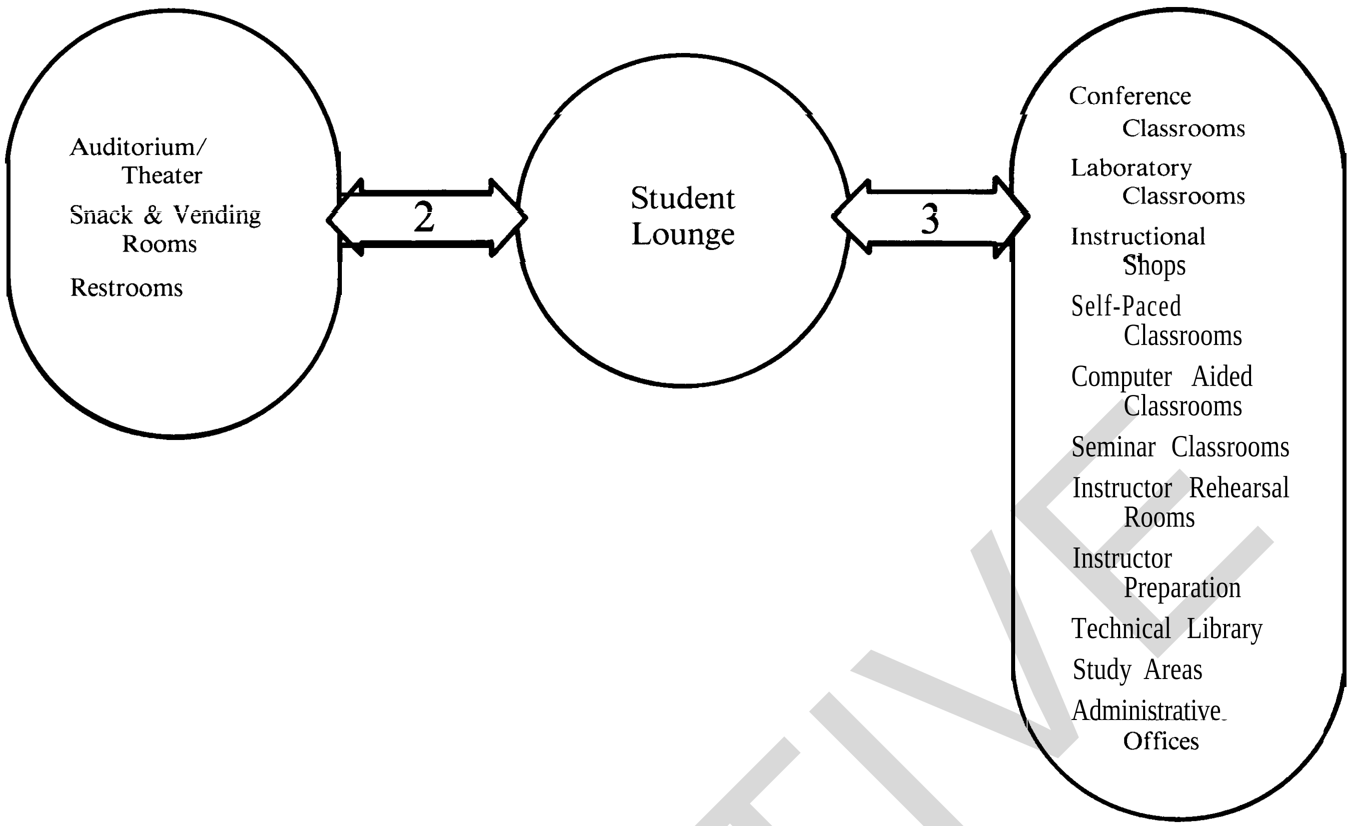


Figure 4-63
Spaces Near Student Lounges.

(2) Vending Areas.
Vending areas should be conveniently located. Each major building should have vending areas. These areas should be easy to service, but placed so as to discourage use by nonschool persons. There should be a vending area in buildings where there is no snack bar or dining facility, or where the nearest exchange facility is 3 to 5 minutes walking distance away.

F. **Environmental Conditions.**

(1) Lighting.
There should be adequate lighting. The general lighting level required is 30 foot-candle (if not otherwise specified).

(2) Thermal.
A mechanical ventilation system should provide adequate air quality. To get rid of smoke, about 30 cubic feet per minute per person of clean air should be provided.

(3) Windows.
Windows help create a relaxed and informal atmosphere by providing daylight and a scenic view. Windows should be provided; a northern or southern exposure is recommended. Direct sunlight from a southern exposure must be controlled by louvered blinds, curtains, etc.

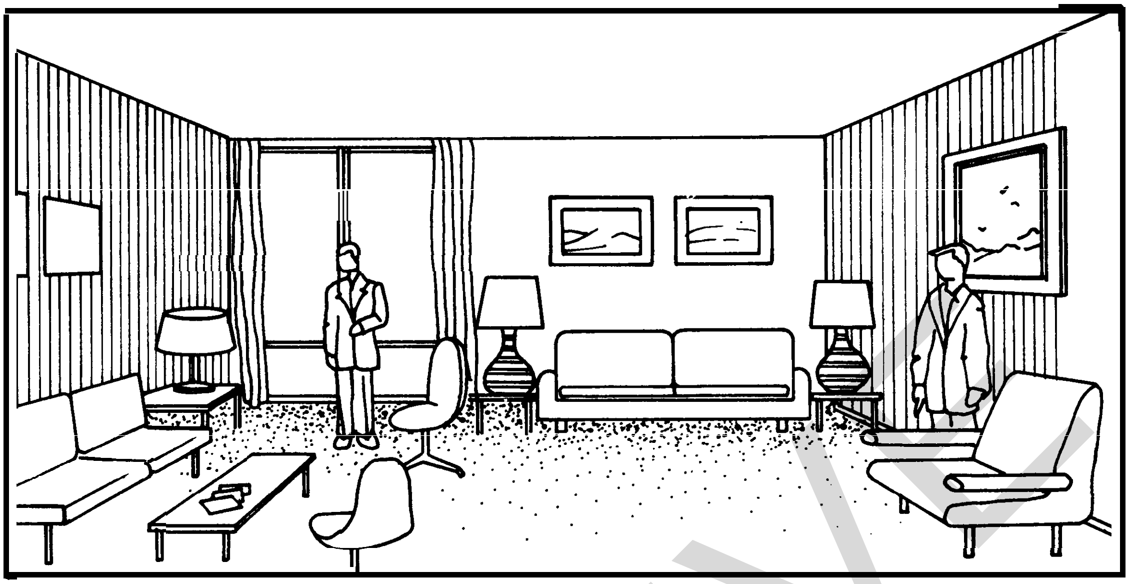
G. Furniture.
Durable tables and chairs should be provided. Furniture should withstand spills of food and drinks, resist cigarette burns, and be easy to wash.

H. Interior Design.

(1) For recommendations, see Figure 4-64. For example color schemes called out in the figure, see the Appendix.

A				C		D	
a	b			a	b	a	

Color Scheme



Interior Design Recommendations	
All fabrics, furniture, and finishes should be durable.	
Room Finishes	
Item	Recommended Characteristics
Walls	Use flat paint in recommended colors.
Floor	Durable surfaces such as tile are highly recommended.
Trim	Use durable vinyl, hardwood, or metal
Furniture & Accessories	
Item	Recommended Characteristics
Seating	Durable vinyl upholstered sofas and chairs are recommended.
Tables	Laminated plastic tables and end tables are durable and attractive.

Figure 4-64
Interior Design Recommendations for Student Lounges.

(2) For general guidance on interior design, see DG 1110-3-122.

I. Criteria.
Table 4-17 lists outline criteria for designing student lounges.

Table 4-17 Criteria for Student Lounges.

Space Criteria	
Area/Person: Seating	30 s.f./person
Standing	6 s.f./person
Ceiling Height	9 ft.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement, air-conditioned	40 cfm (maximum)
Air pressure, mechanical ventilation	100 cfm (maximum)
Air pressure	Negative
Lighting	
General lighting level	30 fc. (maintained)
Visual comfort probability	70, reference: IES Lighting Handbook Applications Volume
Daylighting	Yes, open view necessary
Acoustic	Location of lounges important to insure no interference with instructional activities
Service Criteria	
Plumbing	Vending machine requirements
Electrical	
Power	110 V

4-19 Snack Bars and Vending Areas.

A. Use/Activities.

These spaces are used to sell food, beverages, candy, and cigarettes to students and school personnel. Vending areas usually have adjacent tables if there is no snack bar or dining facility available. Sometimes vending areas are in student lounges. Snack bars provide full food service if there are no other permanent exchange facilities immediately available, and they include a dining room. The Army and Air Force Exchange System (AAFES) normally operates snack bars and vending areas. Detailed programming and design requirements must be obtained through the local AAFES office. Requests for information and coordination should be directed to HQ AAFES, Dallas, TX 75222.

B. Occupants.

The number of students, school staff, and faculty and food service personnel these spaces must accommodate depends on the size and type of the school's food facility. The AAFES operates vending areas and snack bars. Full dining services may be contracted.

C. Equipment/Supplies.

The AAFES determines the type of food preparation, display, vending, or serving equipment used in these spaces. These areas typically have vending machines, waste containers, condiment displays, microwave ovens, and either standup-type tables or tables with chairs.

D. Space Utilization.

These spaces must be large enough to allow users to buy and eat food comfortably. Snack bars/vending areas will provide 12 square feet per seating space; 20 square feet are provided per vending machine.

E. Access/Circulation.

Snack bars should be centrally located, near vertical circulation routes and toilets and directly accessible to a dock for deliveries and trash removal. Although administratively independent of the school, they should relate visually to other school facilities. A vending area should be located within each major building in a place that will discourage its use by nonschool personnel, but still be easy to service. (Figure 4-65 and paragraph 5-2 below).

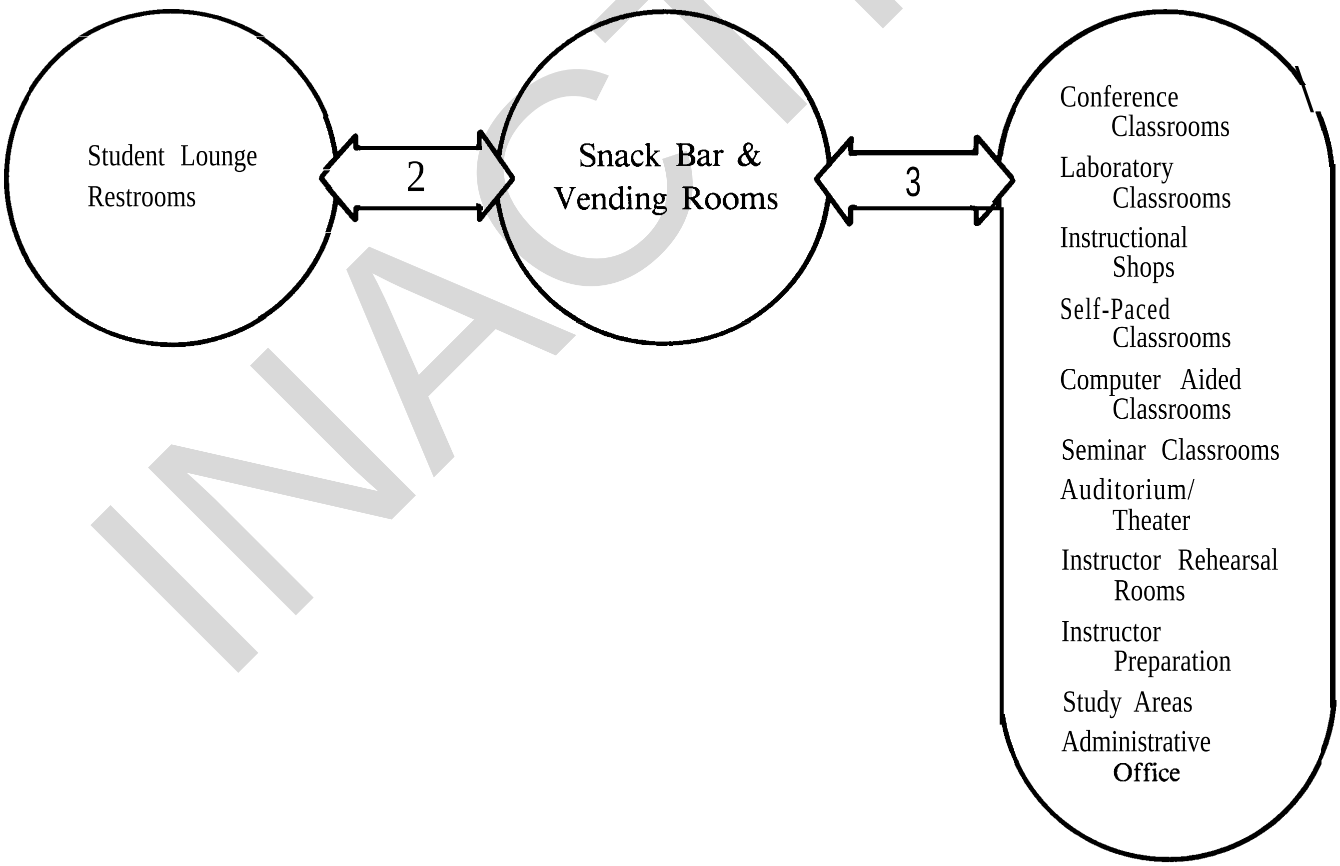


Figure 4-65
Spaces Near Snack Bars and Vending Areas.

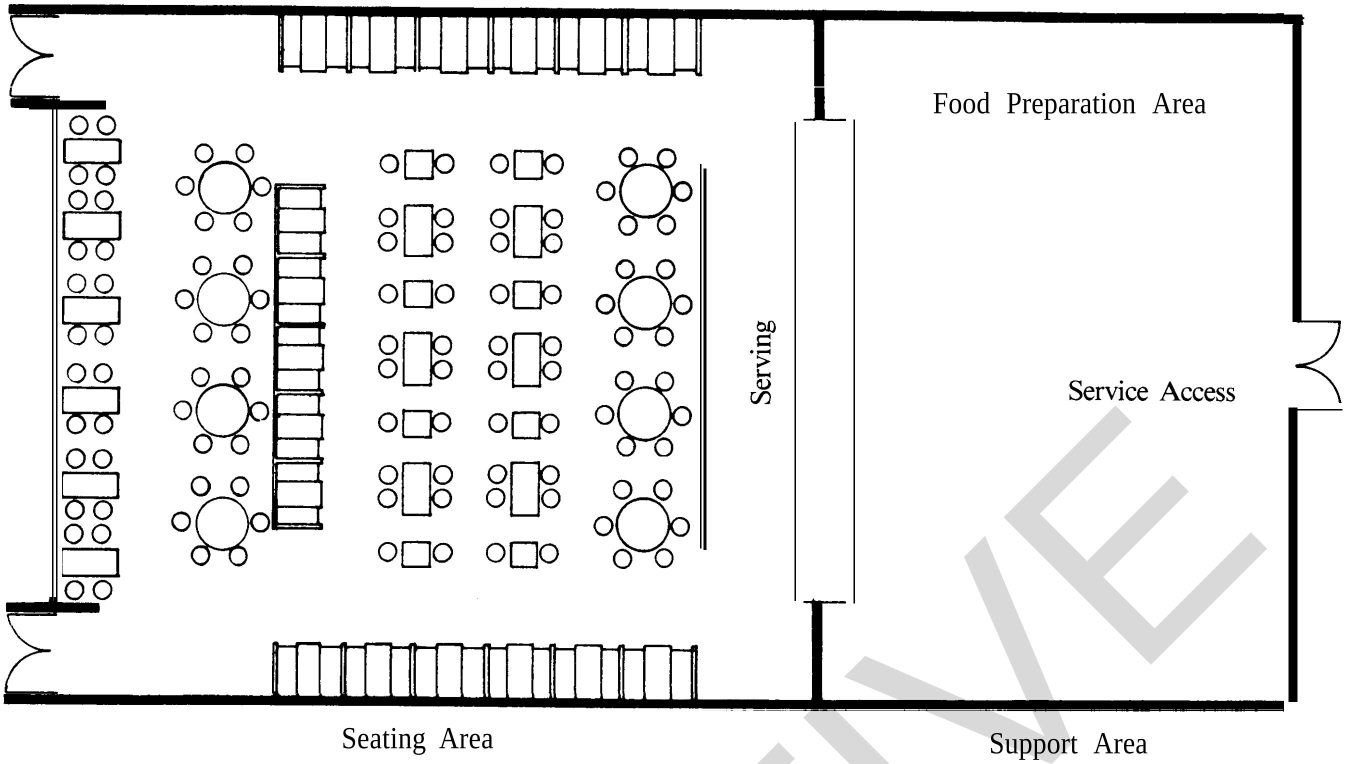


Figure 4-66
Snack Bar Facility.

F. Storage.
The vending area needs nearby storage for stock. The Exchange System sets storage requirements.

G. Environmental Conditions.
Windows should be provided to the full extent allowed by energy conservation regulations.

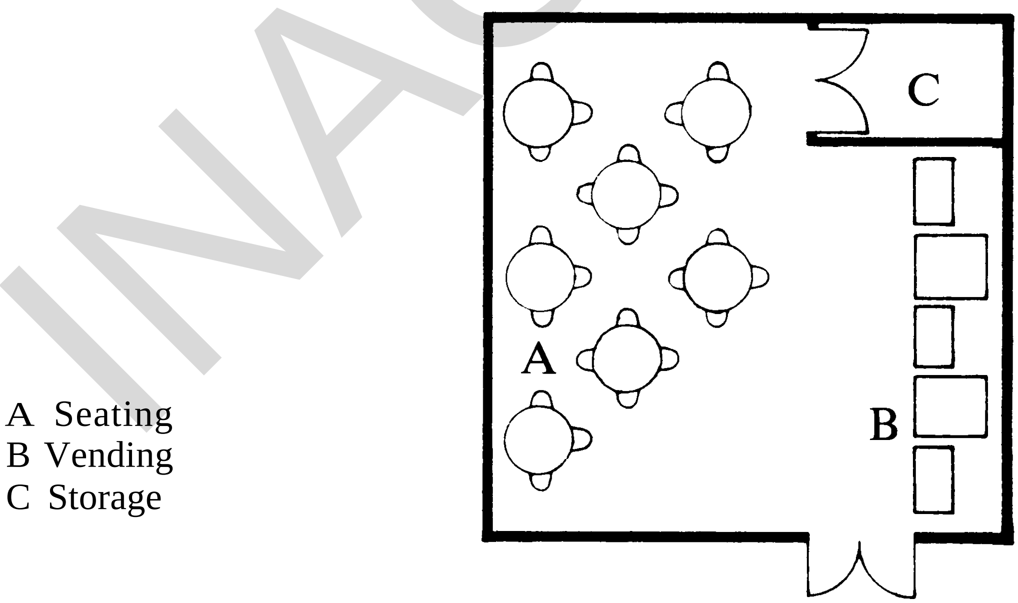
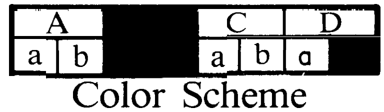
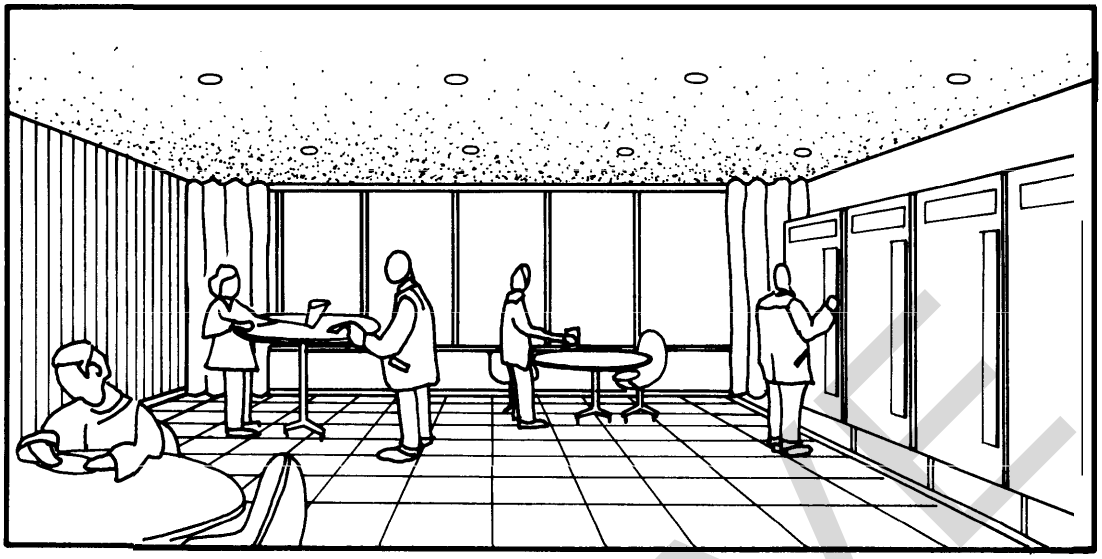


Figure 4-67
Vending Area With Seating.





Interior Design Recommendations

All table surfaces should be laminated plastic.
All fabrics, furniture, and finishes should be durable and easy to clean

Room Finishes

Item	Recommended Characteristics
Walls	Use semi-gloss paint in light shades of recommended colors.
Floor	Durable tile is recommended.
Trim	Use durable vinyl, hardwood, or metal.

Furniture & Accessories

Item	Recommended Characteristics
Seating	Durable vinyl upholstered or molded plastic chairs are recommended.
Tables	Use laminated plastic for table top surfaces.

Figure 4-68
Interior Design Recommendations for Snack Bars and Vending Areas.

H. Furniture.
Durable tables and chairs must be provided. Furniture should withstand food and drink spills, be easy to wash, and resist cigarette burns. A mixed seating arrangement consisting of two- and four-place rectangular tables, four-place booths, and six-place round tables should be provided to accommodate various sizes of customer groups. (Figures 4-66 and 4-67).

I. Interior Design.

(1) For recommendations, see Figure 4-68. For example color schemes called out in the figure, see the Appendix.

(2) For general guidance on interior design, see DG 1110-3-122.

J. Criteria.
Table 4-18 lists outline criteria for designing snack bars and vending areas.

Table 4-18 Criteria for Snack Bars and Vending Areas.

Space Criteria	
Area	12 s.f. per seat; 20 s.f. per vending machine
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	15 per hour (dining); 25 per hour (kitchen)
Air movement	40 cfm (maximum) dining
Air pressure	Positive (dining); Negative (kitchen)
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Serving lighting level	50 fc. (maintained)
Daylighting	Required
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

4-20 Bookstore.

A. Use/Activities.
The service school bookstore sells supplemental training documents, stationery supplies, technical books, and related materials. The AAFES normally operates bookstores. Detailed requirements for programming and design must be obtained through the local AAFES office. Requests for information and coordination should be directed to HQ AFFES, Dallas, TX 75222.

B. Access/Circulation.
The store should be centrally located, near the main entrance, and accessible to a loading dock for deliveries (paragraph 5-2 below).

C. Criteria.
Table 4-19 lists outline criteria for designing bookstores.

Table 4-19 Criteria for Bookstores.

Space Criteria	
Area	Reference: paragraph 4-12
Ceiling Height	9 ft. min.
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour
Air movement	40 cfm
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Daylighting	Yes
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

4-21 Restrooms

A. Use/Activities.
In some cases, restroom areas will also have shower and locker rooms.

B. Occupants.
The population served by a restroom will vary by school and by building layout.

C. Equipment/Supplies.
The type and number of restroom fixtures will vary with the population and area served. When restrooms are renovated, provisions for the physically handicapped must be included.

D. Space Utilization.
AEI - Design Criteria, Chapter 15, for guidance on size.

E. Access/Circulation.

(1) Location.
Washrooms should be convenient to users. Both men's and women's restrooms should be near the administrative area. There should be one restroom (both men's and women's) on each floor of the classroom area. Groups of restrooms should be spaced at intervals not to exceed 500 feet. (Figure 4-69).

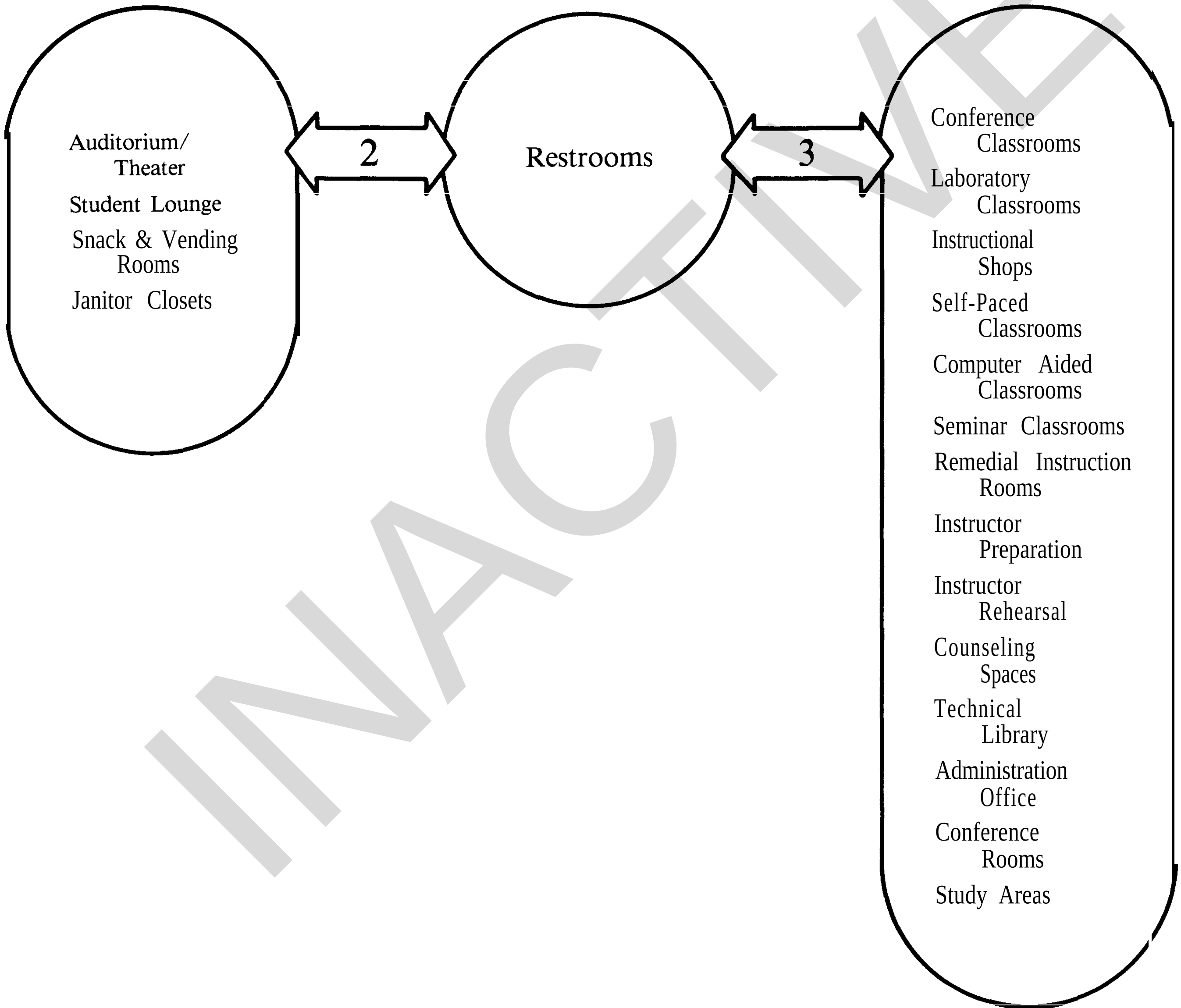


Figure 4-69
Spaces Near Restrooms.

(2) Fixture Arrangement.
Fixtures' arrangement should minimize traffic congestion. The usual arrangement of restroom fixtures is lavatories nearest the door, followed by urinals, water closets, and dressing rooms. Where space is lacking, these fixtures are typically placed along a narrow corridor; urinals are nearest the door to allow a wider aisle.

(3) Fixture Layout.
Fixture layout should be accessible to the handicapped. Refer to AEI - Design Criteria, Chapter 7.

F. Utilities and Wastes.
Restrooms must have enough sewer capacity to support increased use during hourly breaks. Careful consideration should be given to restroom fixture arrangement and its effect on the plumbing and pipe runs. Fixtures should be arranged in batteries. Stall urinals need a trap beneath the floor level. If the floor-slab thickness will not accommodate the trap's indicated average dimension, urinals may be placed on a platform 4 inches high by about 2 feet wide and their surface pitched to the fixtures.

G. Environmental Conditions.

(1) Lighting.
Lighting should be appropriate for washrooms. In general, 20 to 30 foot-candles will adequately light a restroom. Lights should directly illuminate lockers, lavatories, and showers.

(2) Ventilation.
Restrooms must be well ventilated to control odor; 2.0 to 2.5 cubic feet per minute of exhaust ventilation without recirculation is recommended per square foot of floor area. A minimum of 1.5 cubic feet per minute per square foot should be provided.

H. Furniture.

(1) Fixtures.

a. Lavatory fixtures should be chosen for appearance, durability, and ease of cleaning. Lavatories may be leg, counterset, or wall-hung. Wall-hung types are easiest to clean; however, they must be supported on suitable chair carriers to avoid unsightly cracks between wall and fixtures. Lavatories should be white or a light color.

b. Water closets should be selected for appearance, durability, and ease of cleaning. Water closets are either wall-hung or floor (pedestal) types. Floor-type water closets are hard to clean and are recommended only for restrooms whose use will be restricted. Wall-hung water closets are generally recommended for normal-use restrooms. Water closet seats should be unbreakable and have open fronts and an impervious surface. Color recommendations are the same as for lavatories. Self-metering flush valves are recommended for all types.

c. Urinals should be chosen for appearance, durability, and ease of cleaning. Three kinds of urinals can be used: stall, wall-hung, or pedestal types. The wall-hung type is recommended. Partitions or fins are usually placed between pedestal or wall-hung urinals, but rarely between stall urinals. Many wall-hung urinals have integral shields which serve as partitions. If the space between stall urinals is too small for easy cleaning, pockets should be filled flush with impervious surface materials. Urinals are usually white or light-colored.

(2) Partitions.

a. Partition systems should be chosen for appearance, durability, and ease of cleaning. Partitions should stop about 1 foot above the floor for air circulation. Various kinds of metal partitions are available; these include post-and-panel assemblies (with or without overhead bracing) and flush panels with integral posts (floor-supported or ceiling-hung). (Figure 4-70). Floor-mounted partition systems are usually more durable than other types; ceiling-hung types make floor cleaning easy. Partition colors should fit with overall room decor. Subdued and neutral colors are recommended. Partitions should resist corrosion. Compartment dimensions depend on whether doors swing inward or outward.

b. Accessories for restrooms should be easy to use, durable, attractive, and easy to clean and service. Finishes on accessories should be noncorrosive. Double-roll, 15,000-sheet toilet tissue dispensers are recommended. One towel dispenser should serve no more than three lavatories. Automatic hand driers should serve no more than two lavatories. One soap dispenser should be provided for every two lavatories. Dispensers for waterless or other special hand cleaners should be provided in restrooms near laboratories and shops. Each lavatory should have a shelf. Waste containers for paper towels should have an 8- to 10-gallon capacity per towel dispenser. Waste containers should meet Occupational Safety and Health Administration (OSHA) regulations and be easy to remove and empty. Each women's water closet should have a feminine napkin dispenser; these dispensers should include disposal bags. When a women's restroom includes a lounge, there should be an ashtray with each couch.

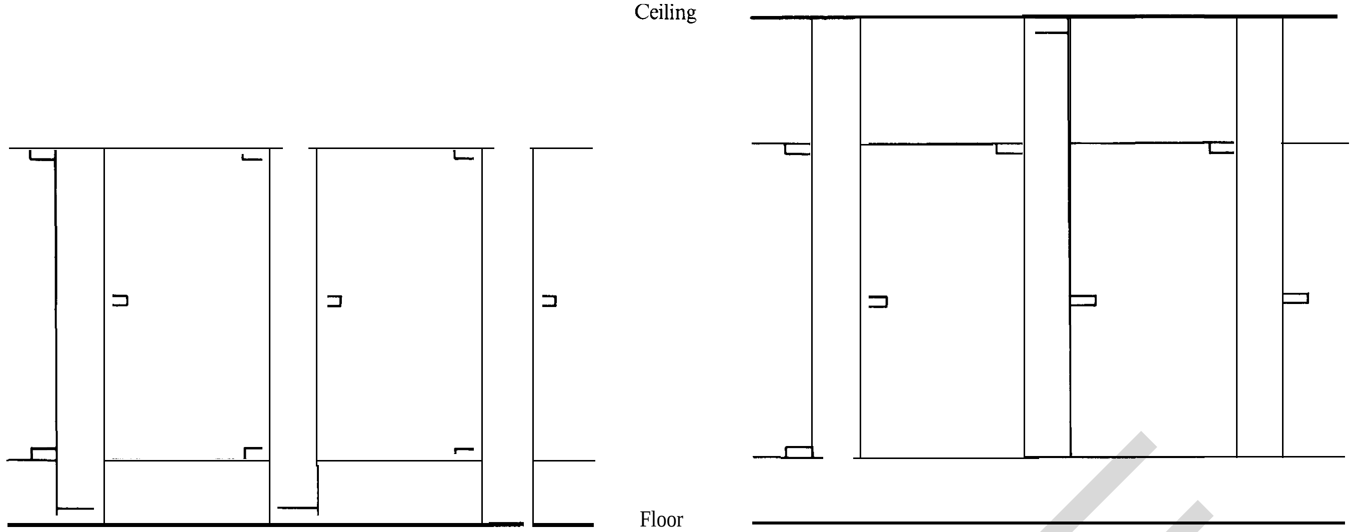


Figure 4-70
Toilet Partition Types.

I. Interior Design.

(1) Maintenance.
All surfaces should be durable. Restroom walls, floors, and ceilings must resist water and water-borne dirt penetration. Floors should be strong enough to support heavy traffic, and soap, water, acid, and alkali contamination. Fixtures should be durable enough to withstand heavy use and cleaning. Restrooms ceilings can be acoustically treated. Items that should be included or considered for restroom use are suitable floor drains in toilet and locker rooms, and hose bibs in toilet and locker rooms.

(2) Recommendations.

a. For recommendations, see Figure 4-71. For example color schemes called out in the figure, see the Appendix.

b. For general guidance on interior design, see DG 1110-3-122.

J. Criteria.
Table 4-20 lists outline criteria for designing restrooms.

4-22 Janitor Rooms.

A. Use/Activities.
These spaces are used to store janitorial supplies and equipment, to obtain water (for mopping), and to dump wastewater. They may also be holding areas for solid waste. In office areas, janitor closets are often used to fill coffee urns or to dump coffee grounds. Management of janitorial services will vary locally; in some cases, such services will be contracted. School personnel will also use these areas for routine or emergency cleanup activities.

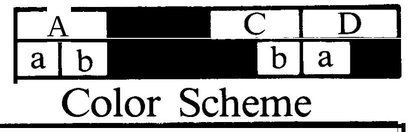
B. Occupants.
The number of janitorial and/or school personnel that will use the janitor closets depends on the size of the school and how janitorial services are managed.

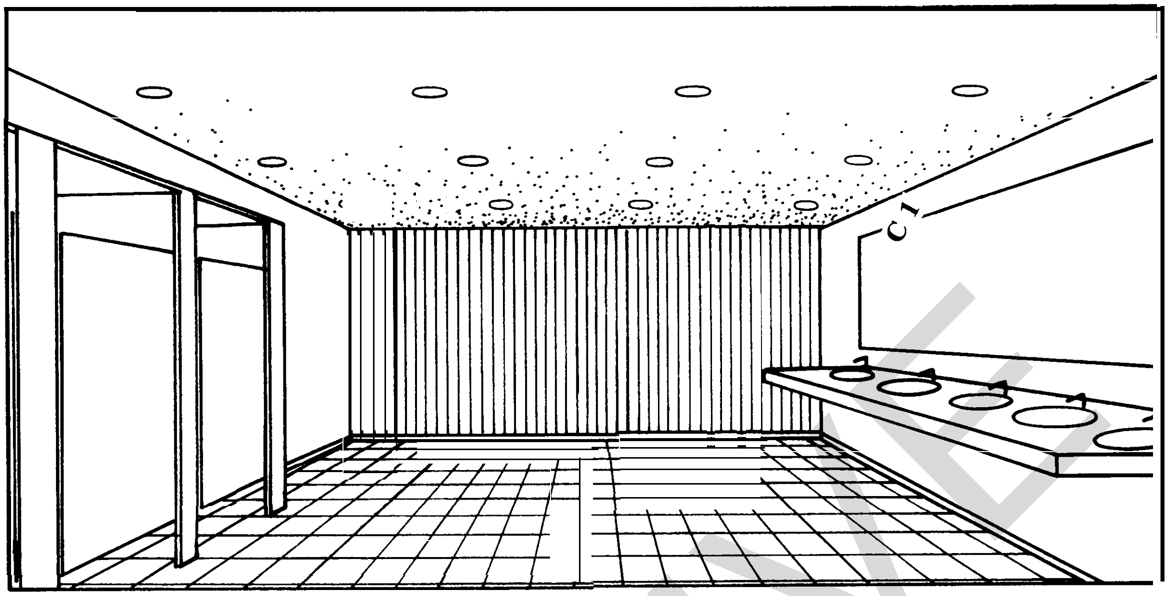
C. Equipment/Supplies.
The amount and type of equipment and supplies to be stored in janitor closets will vary. Sometimes, buffers and floor-cleaning machines, as well as mops and brooms, must be stored. Security for expensive equipment or for contractor-furnished equipment may be needed. Furniture for a supervisor work station (desk and file) may be needed.

D. Space Utilization.

(1) Size.
Each janitor closet should be 48 square feet.

(2) Shape.
The ceiling should be at least 8 feet high, and the room dimensions should be at least 6 by 8 feet.





Interior Design Recommendations

The primary decor concern in restrooms is surface cleanability, durability, and imperviousness to water.

Room Finishes

Item	Recommended Characteristics
Walls	Ceramic tile in recommended colors must be applied to at least the lower five feet of all restroom walls. Gloss paint in recommended colors may be used from the top of the tile to the ceiling.
Floor	Use ceramic tile in recommended colors.

Furniture & Accessories

Item	Recommended Characteristics
Walls	Partition walls should be of a non-rust metal.

Figure 4-71
Interior Design Recommendations for Restrooms.

Table 4-20 Criteria for Restrooms.

Space Criteria	
Area	Reference: Space Use
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	2.5 cfm (minimum)
Air changes	6 per hour (minimum)
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Back	Absorptive, NRC 25 (minimum)
Floor	Absorptive, NRC 25 (minimum)
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

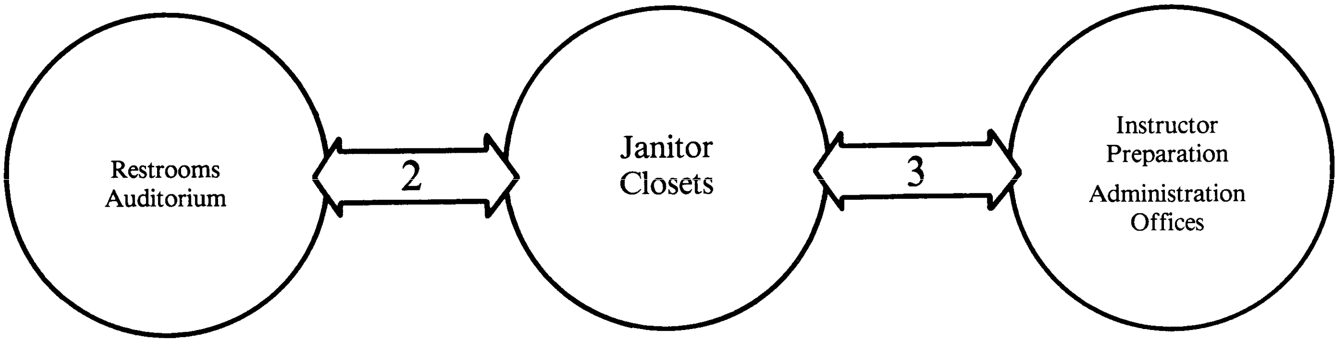


Figure 4-72
Spaces Near Janitor Rooms.

E. Access/Circulation.

(1) Location.
There must be a closet on every floor. One closet is enough for a floor between 9000 and 15,000 square feet. In larger buildings, two closets per floor may be needed. Each janitor closet should be centrally located within the area it serves. (Figure 4-72).

(2) Access.
Janitor closets should be easy to enter but screened from general view. The door to the janitor closet should be self-closing and have a foot-operated doorstop. The door should not have a window and should be labeled "JANITOR" on the outside.

F. Utilities and Waste.
Each janitor closet should have a floor drain.

G. Environmental Conditions.

(1) Lighting.
Each janitor closet should have at least a 30-foot-candle lighting level.

(2) Thermal.
Ventilation should be provided to prevent mildew and odors. There must be at least 0.15 cubic foot per minute of ventilation air per square foot of floor area.

H. Furniture.

(1) The janitor closet should have a cork bulletin board for user or employee notices. Corkboards should be 18 by 24 inches, hung at a convenient height, and on a wall that is away from stacked equipment or boxes.

(2) There should be enough storage for cleaning chemicals and equipment.

(3) Each janitor closet should have a floor service sink with hot and cold water and a 53-foot length of hose.

I. Interior Design.
Floors and walls should have an unmarrable finish. Floors and walls should be salt-glazed brick, ceramic tile, or similar, easily cleaned materials.

J. Criteria.
Table 4-21 lists outline criteria for designing janitor rooms.

4-23 Storage.

A. Use/Activities.
This type of space is used exclusively for storage.

B. Occupants.
Storerooms typically do not have occupants. In a few cases, large storerooms may have someone located near the entrance to control and distribute contents. Storerooms may belong to one organization or may be shared by several.

C. Equipment/Supplies.
The contents of storerooms may include office and general supplies, A-V equipment, mockups, or other training aids. Storerooms may be partitioned for use by several organizations.

D. Space Utilization.
Actual storeroom area will vary with the school's various needs and uses.

E. Access/Circulation.

(1) Location.
Storerooms which house large equipment should be located on an outside wall of the building so they can be accessed from the outside. Infrequently used storerooms should be located in an out-of-the-way area. (Figure 5-2).

(2) Openings and Access.
Materials and equipment should be easy to move. Storerooms should have an overhead (garage-type) door if movement of large equipment and materials is likely. Double doors (i.e., two 3-foot doors) should be provided to allow access from a corridor.

F. Furniture.
Storage rooms should be planned and equipped to keep contents orderly. Enough shelving, cabinets, and racks should be provided and sized to accommodate the items to be stored.

Table 4-21 Criteria for Janitor Rooms.

Space Criteria	
Area	Reference: Space Use
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

G. Special Features.
Internal secure areas should have adequate storage space. A guard and/or an alarm system can be used to provide storeroom security. Keyed locks must be installed.

H. Interior Design.
Surfaces should be durable and easy to maintain. Concrete block walls and concrete floors should be used.

I. Criteria.
Table 4-22 lists criteria for designing storage rooms.

Table 4-22 Criteria for Storage Rooms.

Space Criteria	
Area	Reference: Space Use
Ceiling Height	9 ft. minimum
Floor Loading	Reference: TM 5-809-1, Structural Design
Environmental	
Thermal	
Temperature, maintained operation	68°F. (heating), 78°F. (cooling)
Relative humidity	50-60%
Outside air required/person	10 cfm (minimum)
Air changes	6 per hour
Air movement	40 cfm (maximum)
Air pressure	Negative
Air filtration efficiency	35% (minimum using NBS dust spot test)
Lighting	
General lighting level	30 fc. (maintained)
Acoustic	
Enclosing sound wall rating:	STC 45
Sound reflectance: Ceiling	Absorptive
Walls: Front	Reflective
Side	Reflective
Service Criteria	
Electrical	
Power	110 V
Signal (low voltage)	Clock control as programmed

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

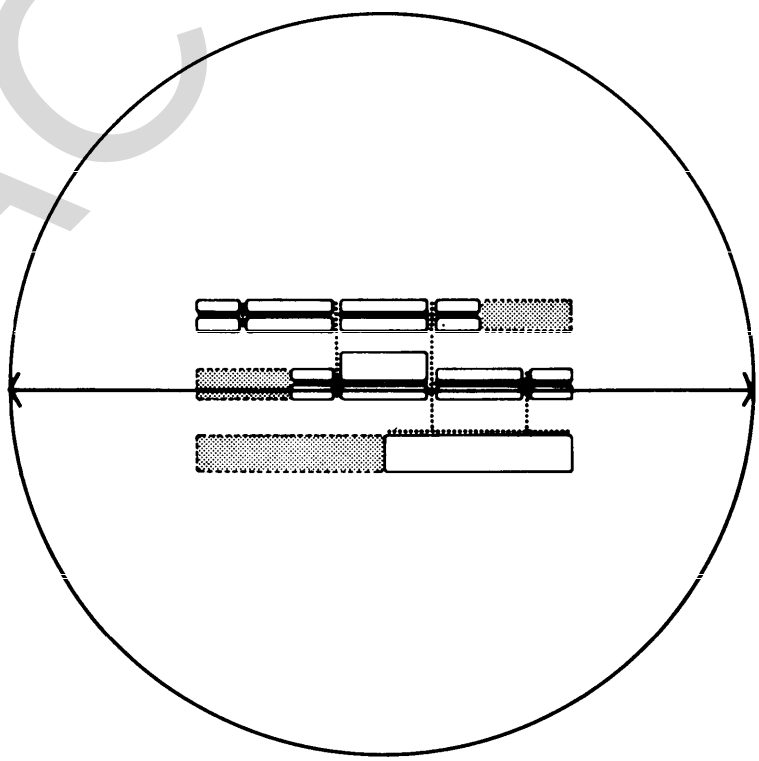


Figure 5-1
Walking Distances and School Planning

	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	3 ABD																					
Instructional Shops	3 AB	3 AB																				
Self-Paced Classrooms	3 AB	3 AB	3 AB																			
Computer-Aided Instruction Classrooms	3 AB	3 AB	3 AB	3 AB																		
Seminar Classroom	3 AB	3 AB	3 AB	3 AB	3 AB																	
Auditorium/Theater	3 ABD	3 AB	3 AB	3 AB	3 AB	3 AB																
Instructor Preparation	3 A	1 AD	1 AD	3 A	3 A	3 A	X															
Instructor Rehearsal	X	1 AD	1 AD	3 AB	3 AB	3 AB	X	2 AE														
Counseling Offices	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	X	1 A	X													
Remedial Instruction	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	X	1 A	X	2 AB												
Technical Library	4 AB	4 AB	4 AB	4 AB	4 AB	4 AB	X	3 A	X	X	X											
Study Areas	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	X	3 AB	X	3 AB	3 AB	X										
Project Room	1 D	X	X	X	X	X	1 D	X	X	X	X	X	X									
Administrative Offices	4 A	4 A	4 A	4 A	4 A	4 A	4 A	4 A	4 A	X	X	4 A	X	X								
Conference Rooms	4 A	4 A	4 A	4 A	4 A	4 A	4 A	4 A	4 A	X	X	X	X	X	2 A							
Student Lounge	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	X	X	3 A	3 B	X	3 A	X						
Sncak/Vending Rooms	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	2 AB	3 A	3 A	X	X	3 B	3 B	X	3 A	X	2 AB					
Bookstore	4 AB	4 AB	4 AB	4 AB	4 AB	4 AB	X	4 A	4 A	X	X	4 A	3 B	X	4 A	X	X	X				
Restrooms	3 AB	3 AB	3 AB	3 AB	3 AB	3 AB	2 AB	3 A	3 A	3 A	3 A	3 AB	3 B	X	3 A	3 A	2 AB	2 AB	X			
Janitor	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	X	3 A	X	X	2 A	X	2 A		
Storage	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	3 A	X	3 A	3 A	X	3 A	3 A	X	3 A	

Strength of Relationship
1. Adjacent
2. near 40 ft.
3. Near 480 ft.
4. Near 1920 ft.

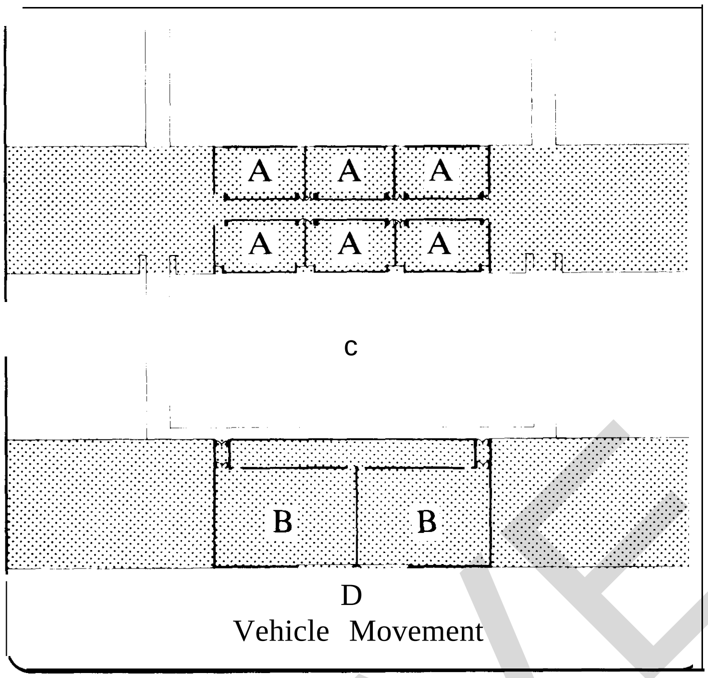
Reasons for Relationship
A. Staff Circulation
B. Student Circulation
C. Supply Circulation
D. Shared Equipment
E. Control

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.

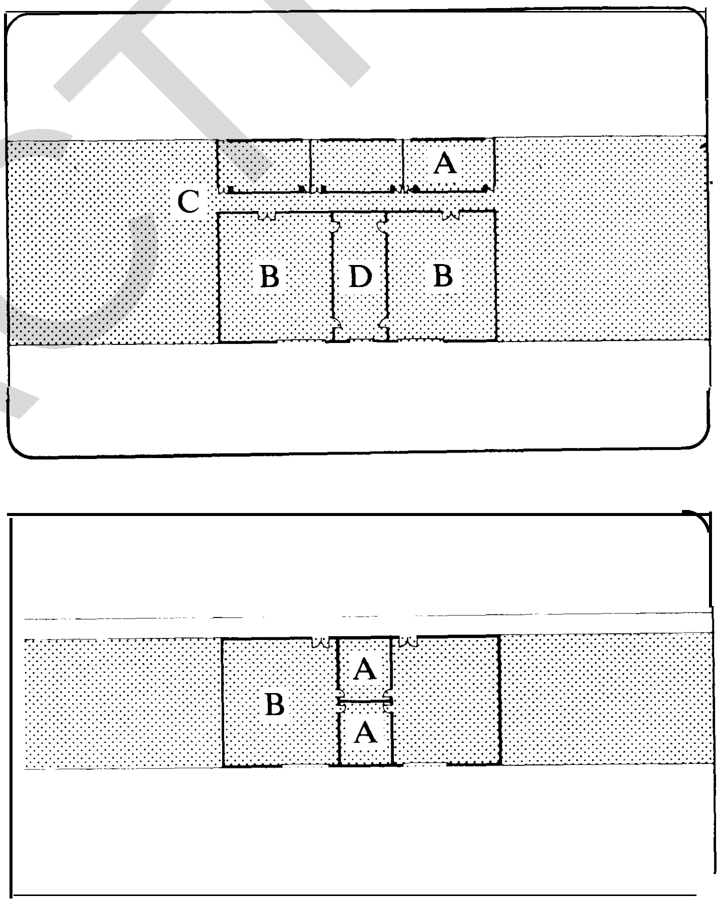
c. Walking distances define the diameters of circular planning areas for service school facilities. Potential expansion of schools must also be programed to take place within the limits of these orginal planning areas. (Figure 5-l). Of course, planning a facility within one of these areas does not guarantee 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

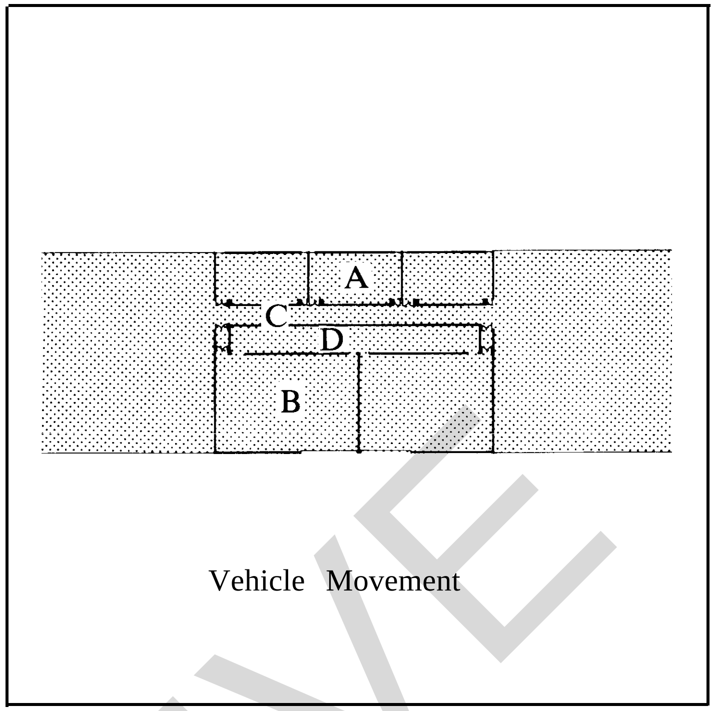
Figure 5-2
Open Space Separation of Class and Shop Areas.



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

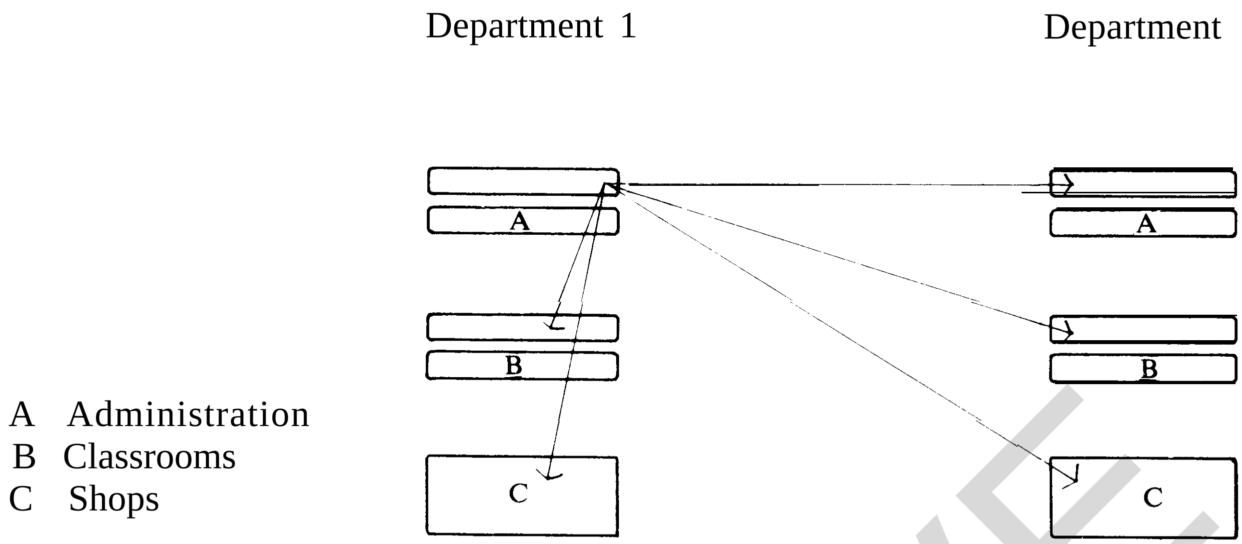


Figure 5-5
Separate Department Organization

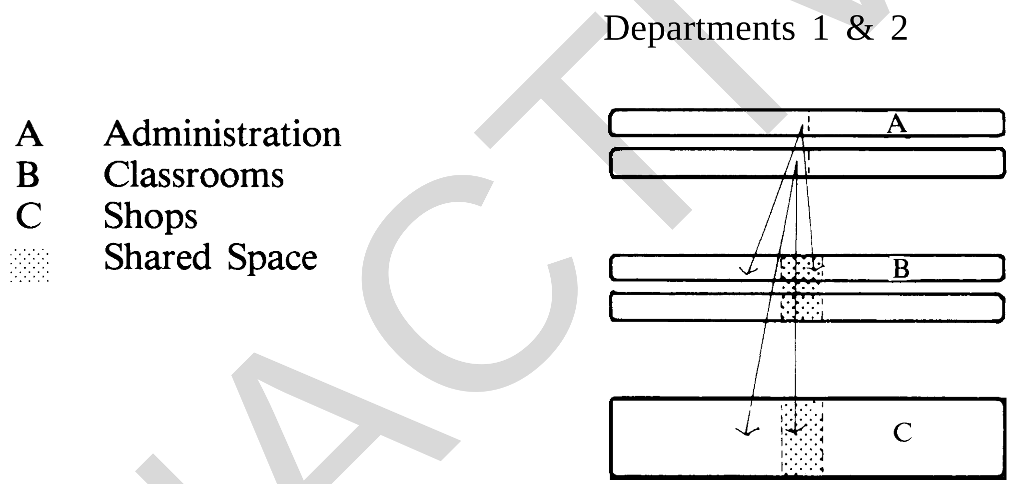


Figure 5-6
Adjacent Departments and Shared Space

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

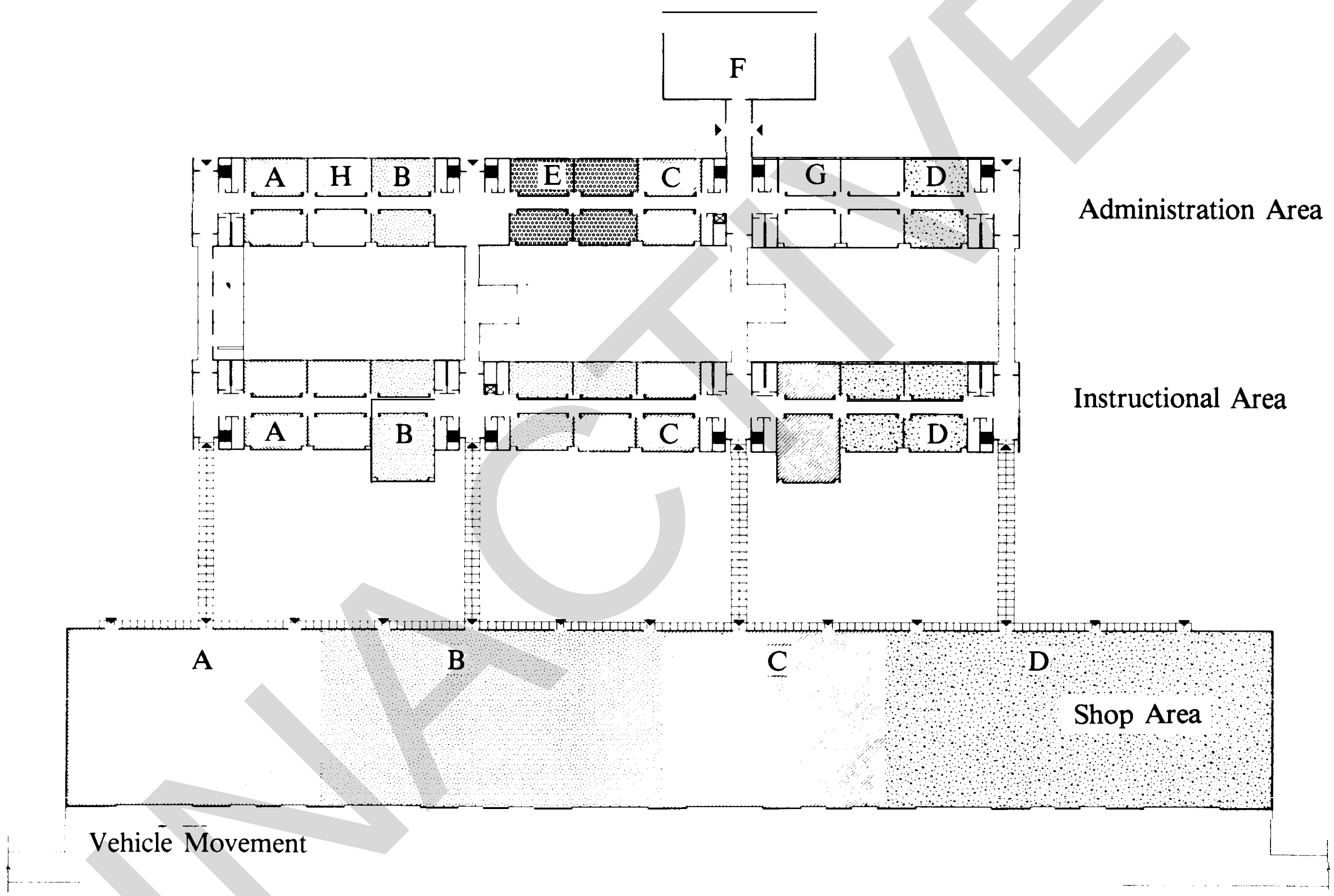


Figure 5-7
Department Locations in School

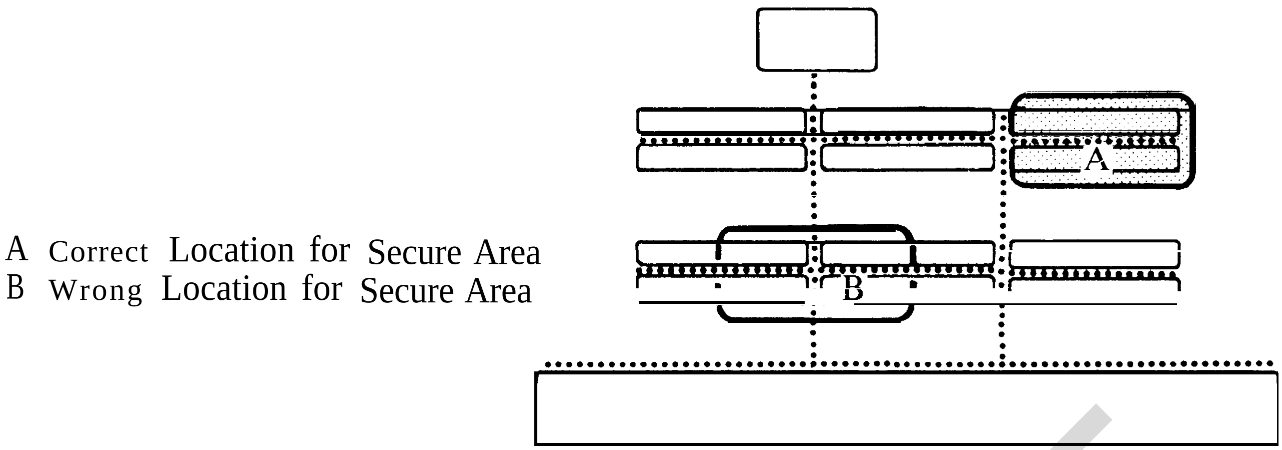


Figure 5-8
Locating Internal Secure Areas.

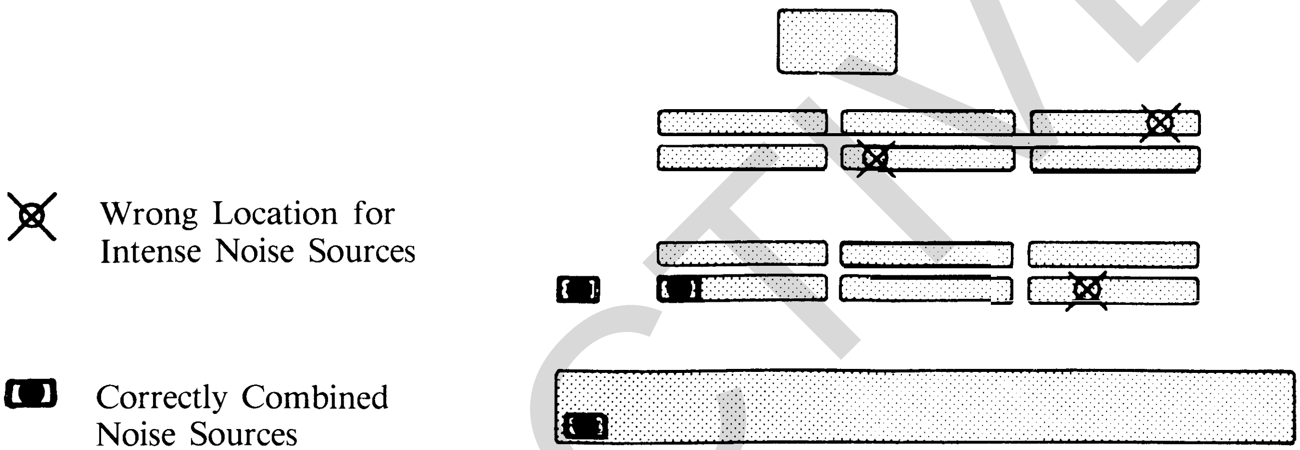


Figure 5-9
Locating Intense Noise Sources.

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.

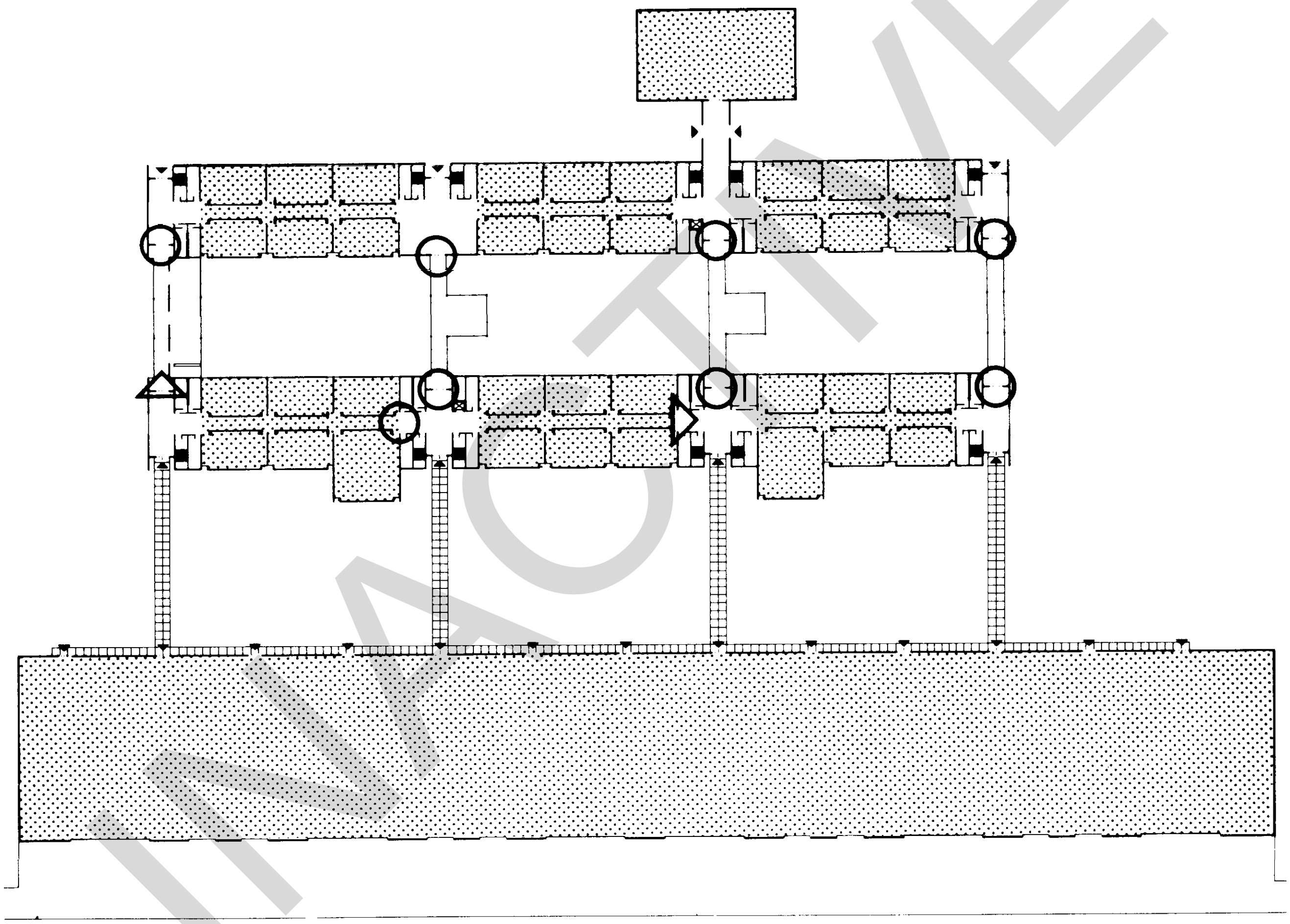
Components of building mechanical and electrical systems, such as HVAC equipment, exhaust fans, transformers and rectifiers, can be sources of excessive noise, especially if located in or near instructional spaces. This noise shall be controlled either by relocating the source outside the instructional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

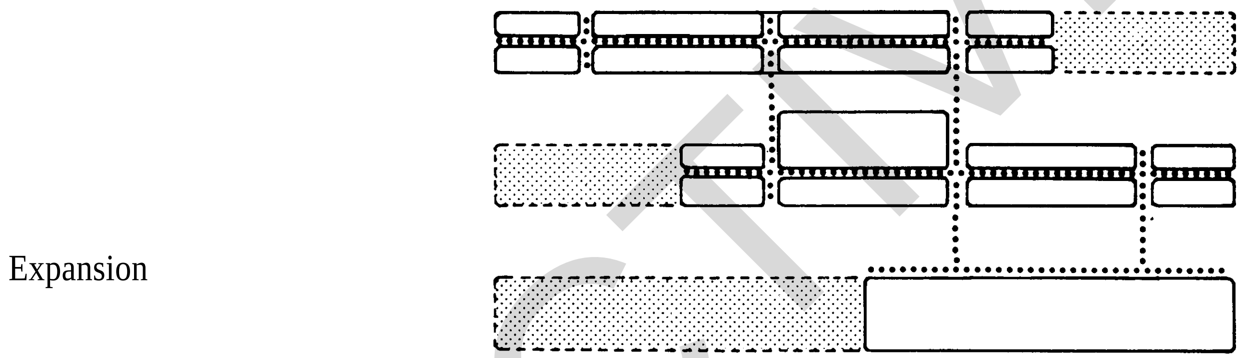


Figure 5-11
Expansion of Large Schools.

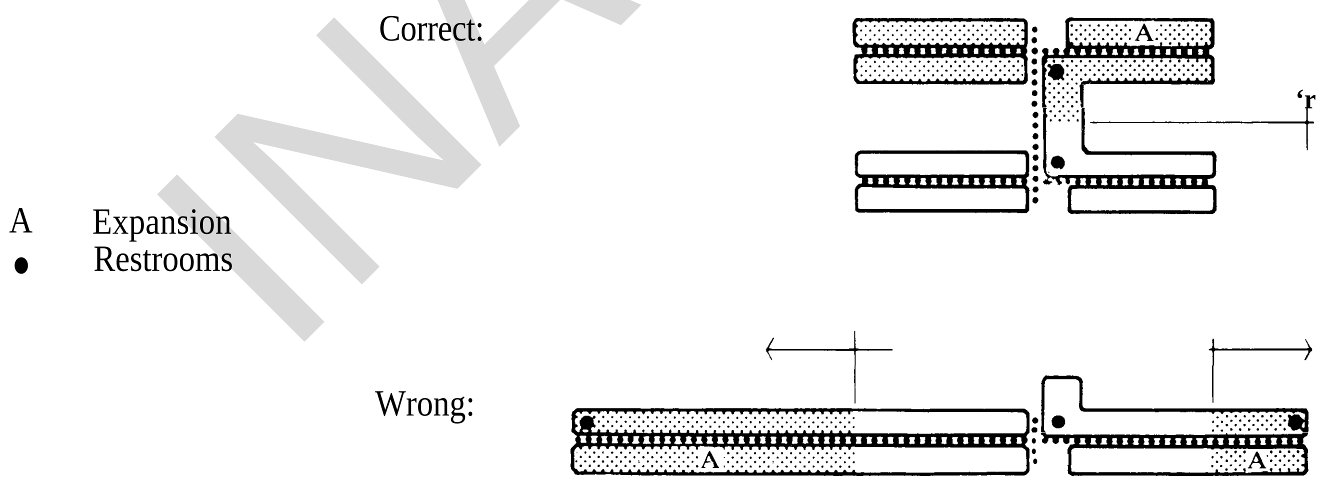
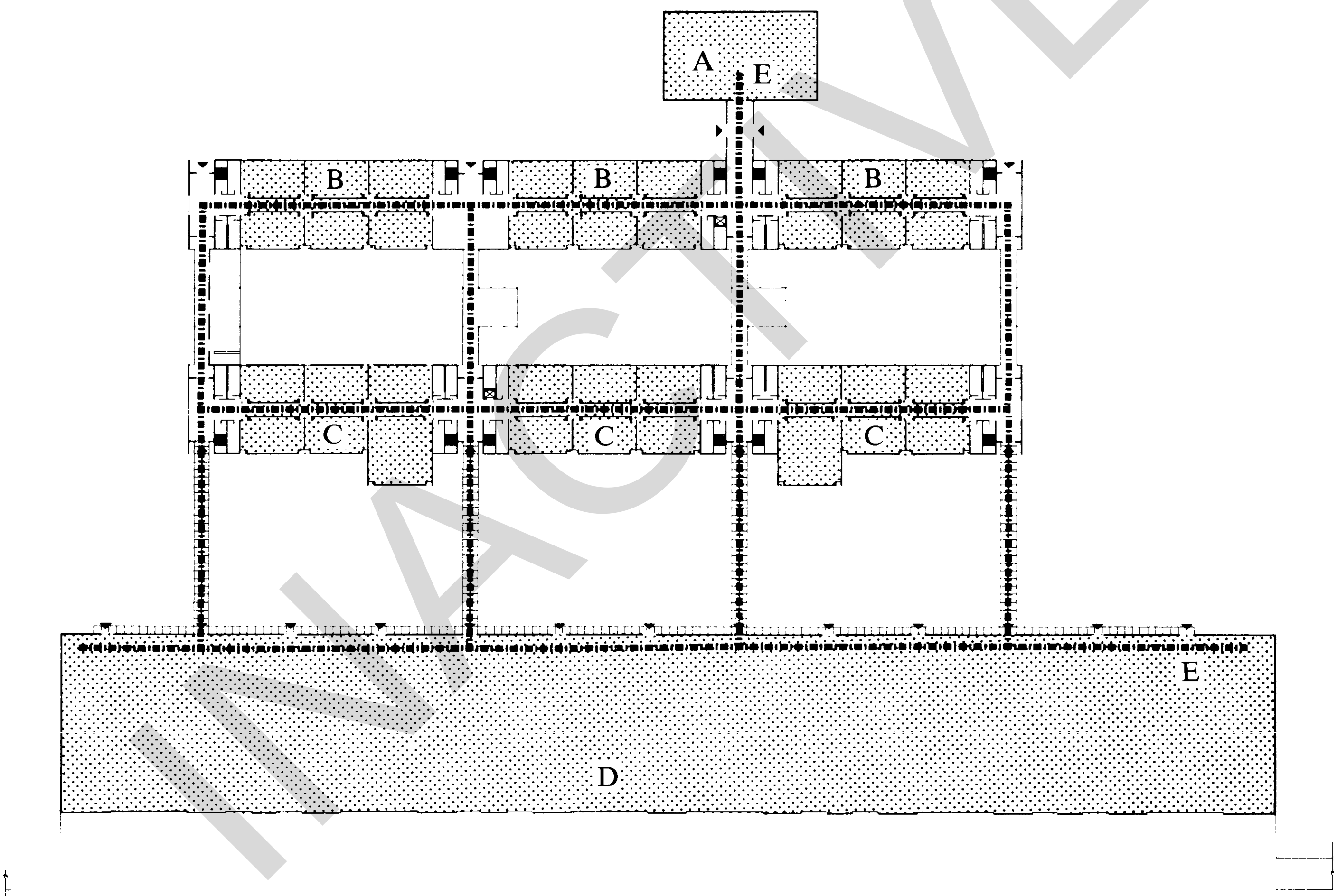


Figure 5-12
Expansion of Small Schools.

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.

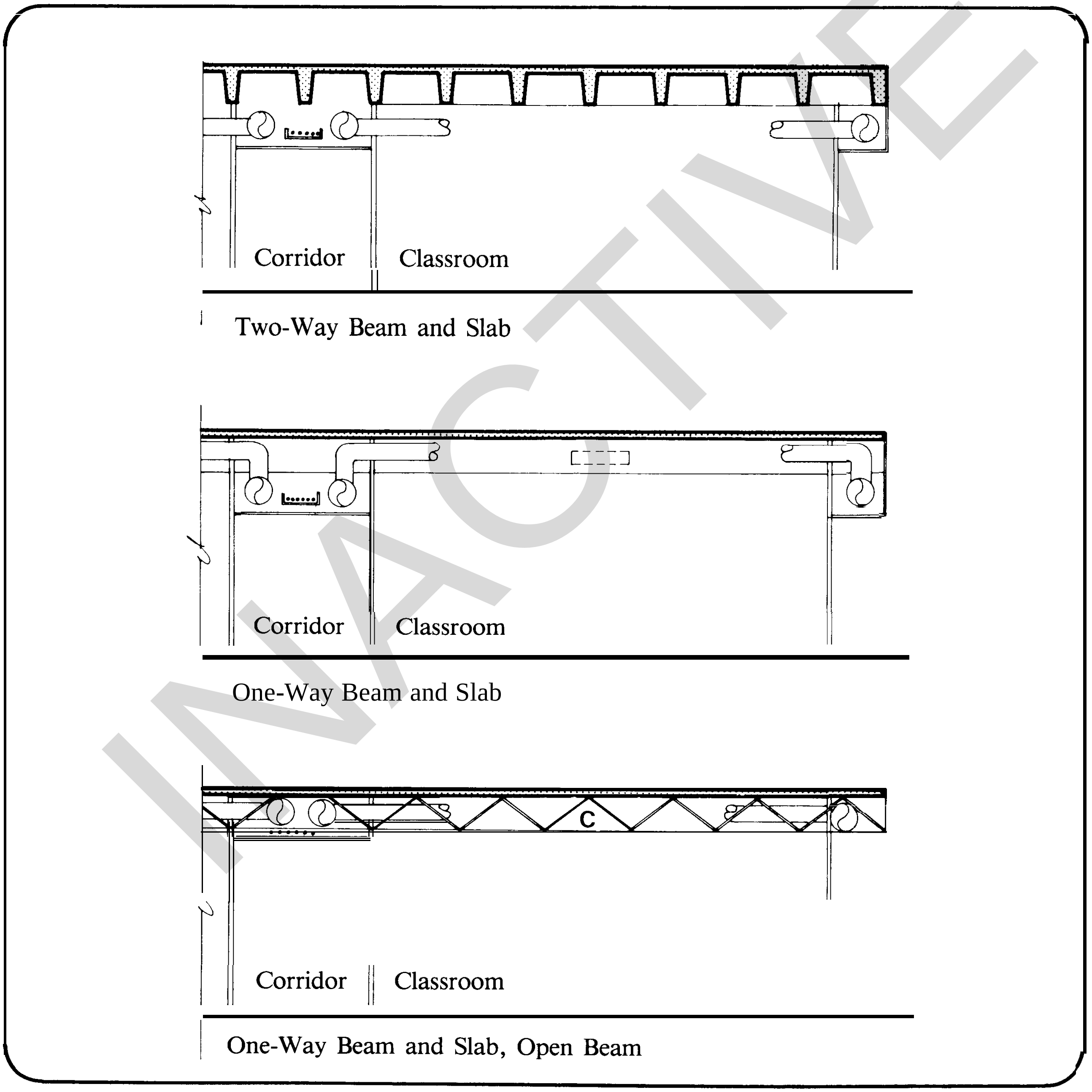


Figure 5-14
Integration of Utilities and Structure

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).

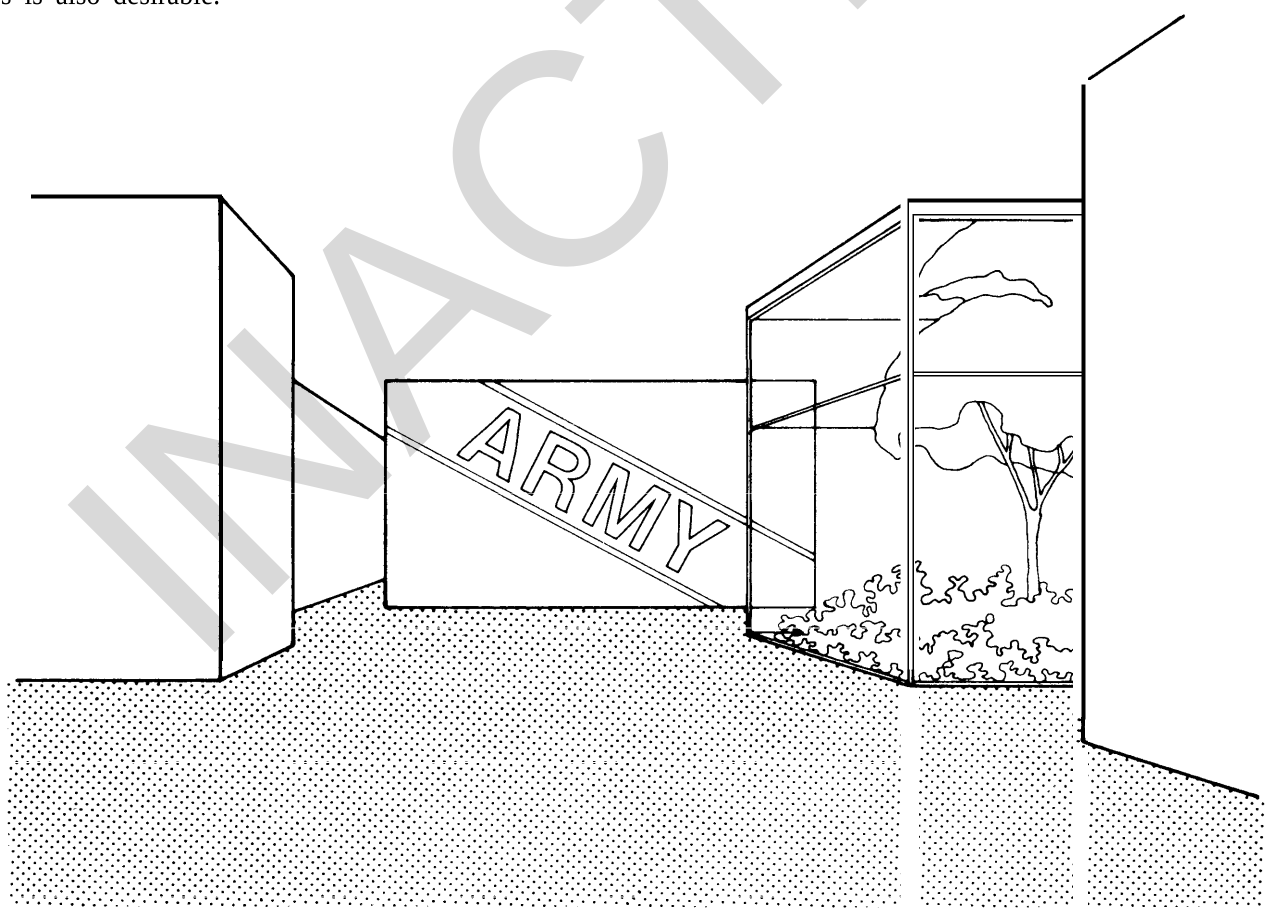


Figure 5-15
Visual Interest in Corridors

6-1 General

This chapter illustrates the application of the design criteria discussed in previous chapters. Four typical service schools, each having different area characteristics, have been selected to serve as illustrations:

A. A 30,000 sq. ft. school whose instruction space is entirely devoted to classrooms and labs (see Figure 6-1 below).

B. A 150,000 sq. ft. school whose ratio of classroom/lab space to shop space is 6:1 (see 6-2 below).

C. A 150,000 sq. ft. school whose ratio of classroom/lab space to shop space is 1:4 (see Figure 6-3 below).

D. A 400,000 sq. ft. school whose ratio of classroom/lab space to shop space is 1:1 (see Figure 6-4 below).

In addition, a plan depicting the expansion of a service school in three phases to an ultimate size of 400,000 sq. ft. is shown in Figure 6-5. This chapter does not prescribe definitive design solutions; rather it uses hypothetical models to demonstrate the ways in which the criteria contained in this manual may be applied.

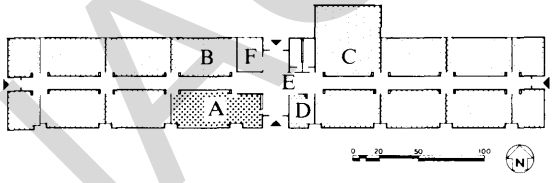
In paragraphs 6-2 through 6-5 each school is briefly described and its characteristic features noted. Paragraph 6-6 then discusses the ways in which these schools exemplify specific design criteria and principles. Utilities requirements for each school are furnished in paragraph 6-7.

6-2 Illustrative Design for 30,000 Sq. Ft. School

This small, classroom-oriented school utilizes single-story construction. It typifies either an addition to an existing facility or a single independent building. It contains ten 1500 sq. ft. classroom modules, a large 125-man classroom, and four instructor preparation spaces. The student lounge and the restrooms are centrally located, as is the administration area. The administration area occupies approximately 10% of the total functional space.

6-3 Illustrative Design for 150,000 Sq. Ft. School (Classroom/Shop Ratio, 6:1)

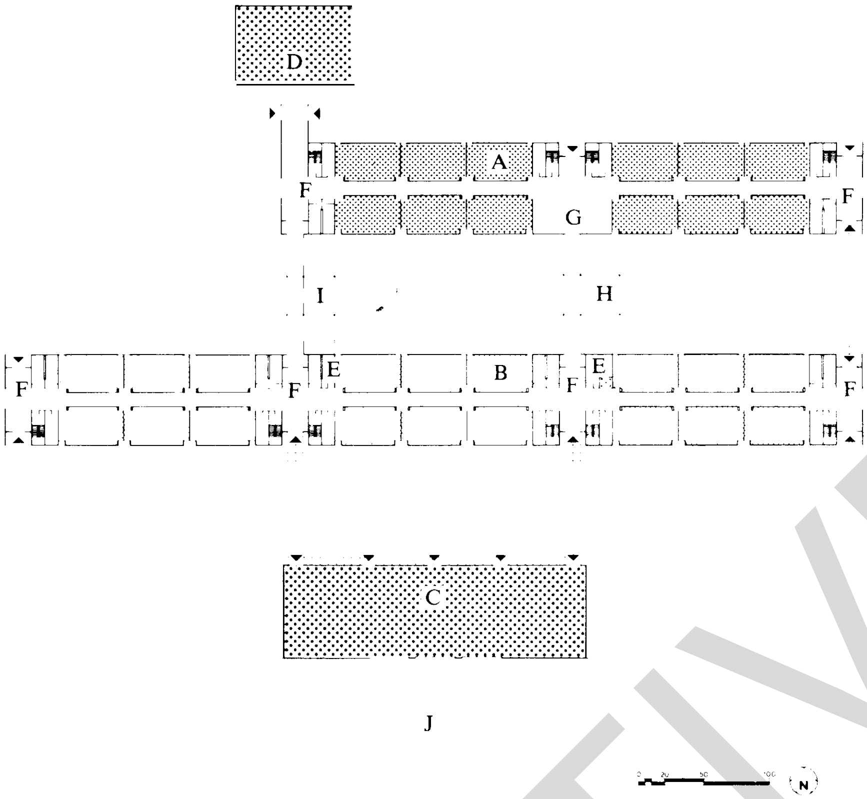
Because this school devotes a majority of its space to classroom functions, the facility is designed with a two-story classroom building. The administration and shop areas, which occupy less space, are in single-story structures. The school contains the full range of service school activity spaces: administrative areas, classrooms, shops, and a technical library. The library is located adjacent to those administrative elements which it most frequently serves. For ready access, support spaces such as the reception area, the student lounge, the snackbar, and restrooms are located at circulation nodes or along primary circulation routes.



A Administration
B Classroom/Labs
C Large Conference Classroom
D Instructor Preparation
E Restrooms
F Student Lounge

Description: Instruction area is totally Conference/Lab Space. Single-story Building.
Utilities: Refer to Section 6-7.

Figure 6-1
Illustrative Plan, 30,000 Sq. Ft. School.



A Administration
B Classroom/Labs
C Shops
D Library
E Instructor Preparation
F Restrooms
G Reception
H Student Lounge
I Snackbar
J Apron

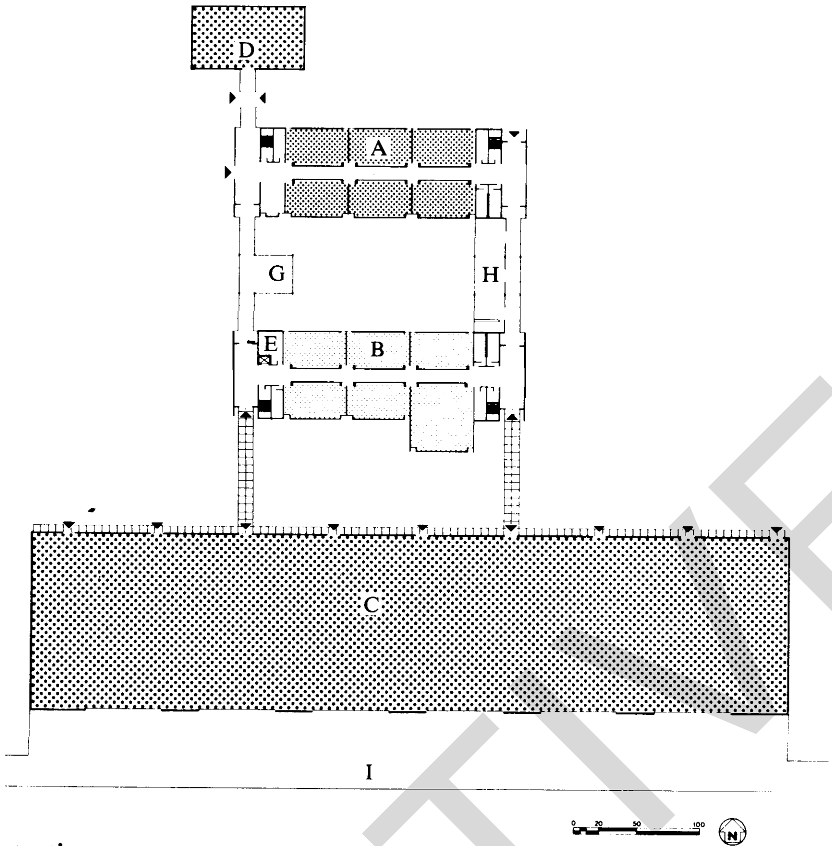
Description: Ratio of Classroom/Lab Space to Shop Space is 6:1. Administration — One- and Two-story Buildings. Classroom/Labs — Two Stories.

Utilities: Refer to Section 6-7.

Figure 6-2
Illustrative Plan, 150,000 Sq. Ft. School
(Primary Instruction Space; Classroom).

6-4 Illustrative Design for 150,000 Sq. Ft. School
(Classroom/Shop Ratio, 1:4)

The educational characteristic of this school is that most of the school's total space is devoted to shop instructional areas. Because of this and the fact that such schools typically require smaller administration areas, the administration and classroom buildings are single-story construction. The shop building is also single-story, but with high ceilings and the potential for mezzanine level support areas. The library is adjacent to the administration building, and the support spaces - lounge, snack bar, restrooms - are located along primary circulation routes. For utilities estimates see paragraph 6-7.



A Administration
B Classroom/Labs
C Shops
D Library
E Instructor Preparation
F Restrooms
G Reception
H Student Lounge
I Snackbar
J Apron

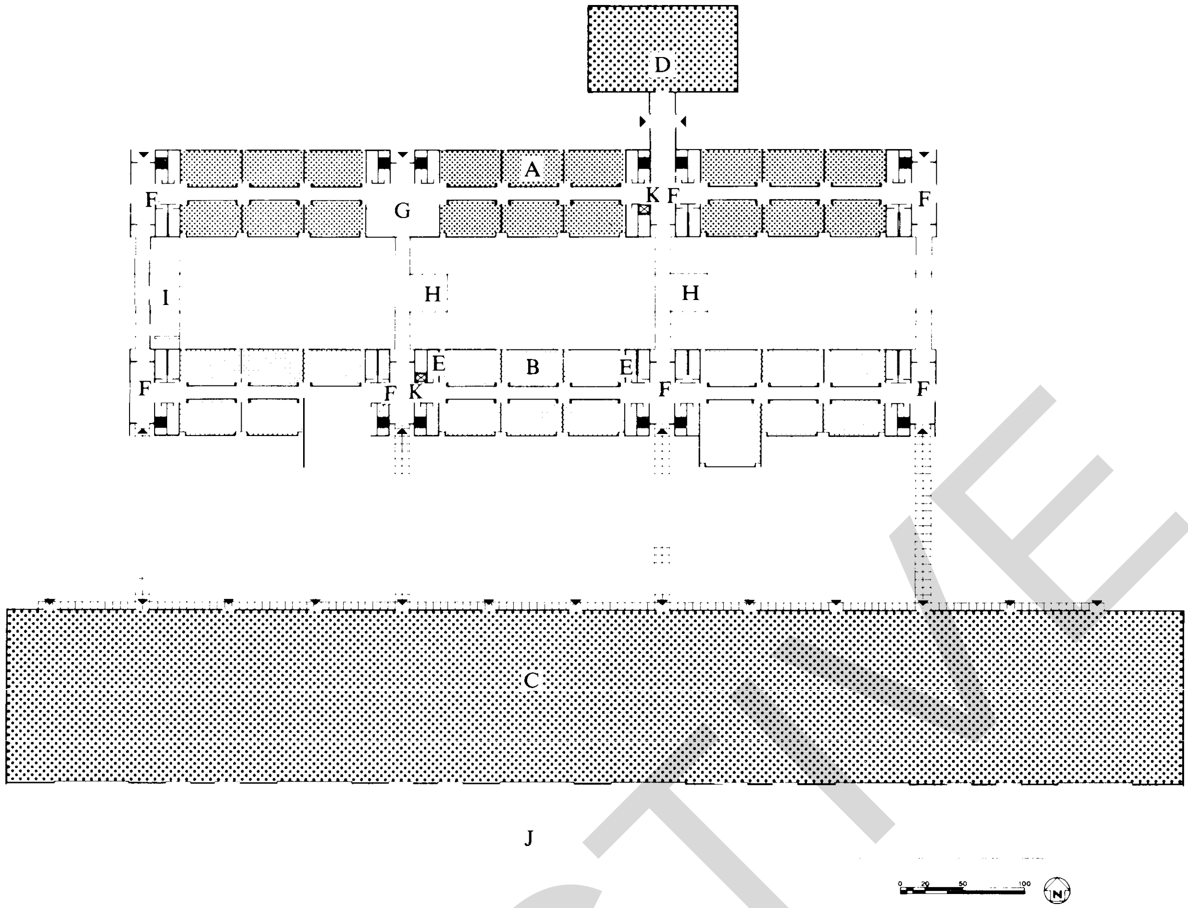
Description: Ratio of Classroom/Lab Space to Shop Space is 1:4. Administration — One Story. Classroom/Labs — One Story.

Utilities: Refer to Section 6-7.

Figure 6-3
Illustrative Plan, 150,000 Sq. Ft. School
(Primary Instruction Space; Shop).

6-5 Illustrative Design for 400,000 Sq. Ft. School

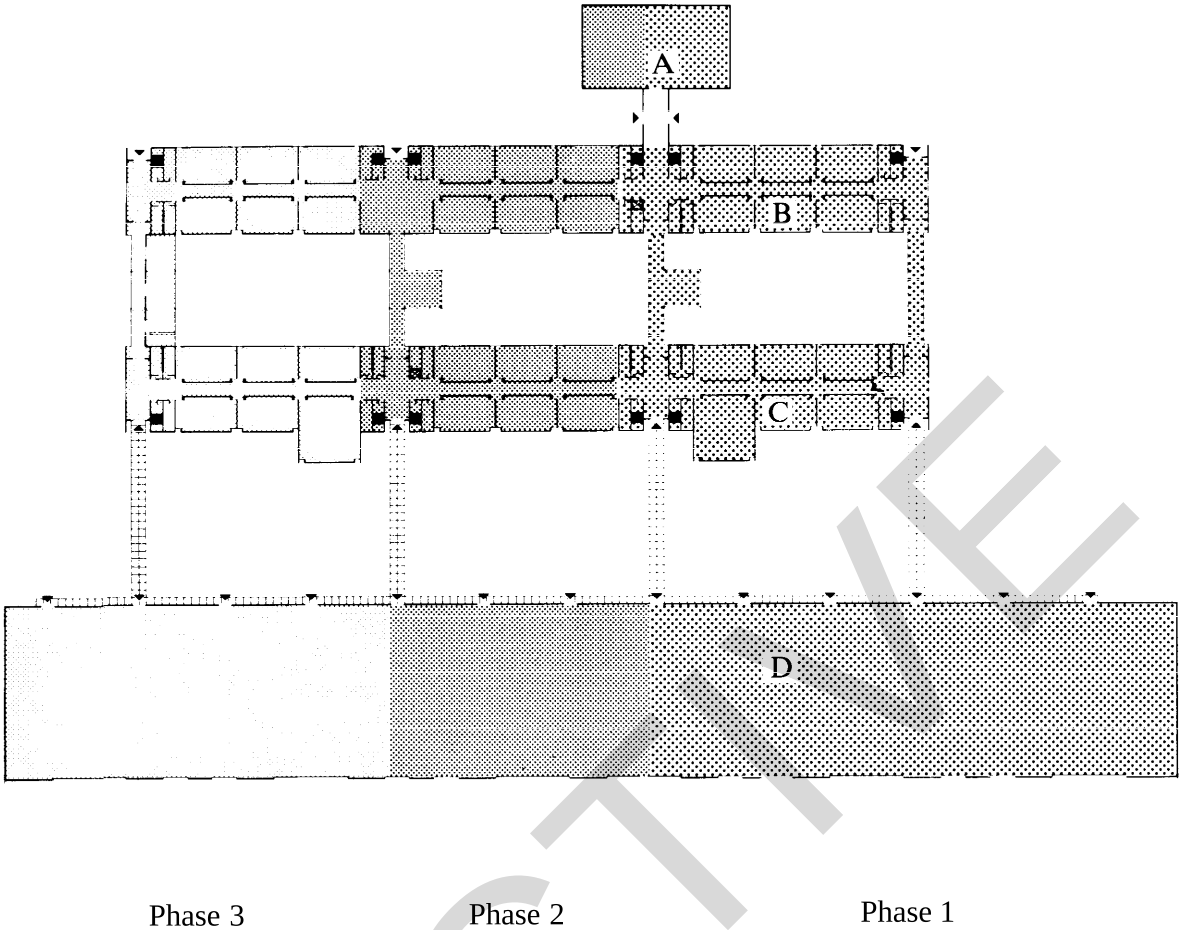
This is a large school whose educational mission requires that equal space be programed for classroom and shop instruction. In a school of this size, compact three-story construction produces the most efficient administration and classroom buildings. The shop building is single-story, high-ceiling construction. The library is located near the administrative element with which it has the closest functional affinity. The support spaces are located at circulation nodes or along primary circulation routes. For utilities estimates see paragraph 6-7.



A Administration
B Classroom/Labs
C Shops
D Library
E Instructor Preparation
F Restrooms
G Reception
H Student Lounge
I Snackbar
J Apron
K Elevator

Description: Ratio of Classroom/Lab Space to Shop Space is 1:1. Administration — Three Stories. Classroom/Labs — Three Stories.
Utilities: Refer to Section 6-7.

Figure 6-4
Illustrative Plan, 400,000 Sq. Ft. School (Equal Classroom and Shop Area).



A Technical Library
B Administration
C Classroom
D Applied Shop

Figure 6-5
Illustrative Plan, 400,000 Sq. Ft. School
(Three Phase Construction)

6-6 Analysis of Illustrative Designs

A. Function.

(1) Spaces are organized to group common functions. With the exception of the 30,000 sq. ft. school, each design zones major functional areas (i.e., administration, classroom instruction, shop instruction, and technical library) as separate elements. This allows different activities to operate independently while maintaining close proximity and increases the school's flexibility by allowing departments to share adjacent administrative and instructional spaces (see paragraph 5-2b(l) above). It also allows spaces to adapt quickly and easily to functional changes. For example, classrooms can be readily converted into labs or seminar rooms since all the necessary features (e.g., movable partitions and adaptable lighting controls) have been designed into the classroom building and since all the necessary instructional equipment and materials are consolidated there. These advantages also apply to the 30,000 sq. ft. school, since that design consolidates administrative and instructional spaces within a single building.

(2) Activity areas are spatially related according to their functional affinities (see paragraph 5-2a.). Classrooms are close to shops and to the administrative area. Since it is usually unnecessary for the administration area or the technical library to be close to the shop area, these two elements are located on one side of the school, and the shops on the other. In all cases, the technical library, because it is dedicated space and performs a unique and independent function, is separated from other functional elements.

(3) The spaces are organized to allow direct, efficient circulation with minimal disruption of intermediate areas. Common use facilities, restrooms, student lounges, snackbar, reception areas, are centrally located. In the case of the 30,000 sq. ft. school, these facilities are located near the center of the building; in the other schools, they are located at circulation nodes or along primary circulation routes. The shops are located along the periphery of the school so that vehicular traffic enters the shop area from one side pedestrian traffic from the other (see paragraph 2-4b(3)(c)). In all the designs which include a shop building, vehicular and pedestrian traffic is separated in this manner.

(4) Noise-generating activities are consolidated and separated from the other activities. Separating the shop building from the rest of the school and placing it along the school's periphery reduces the disruption caused by noise generated in shop areas. (See paragraph 5-2b(3)(a)).

(5) The structures are designed to accommodate the standard classroom module. The structural support frame is along the corridor and exterior wall line; the interior walls are non-loading-bearing. In addition, common framing dimensions are employed to the maximum extent possible. These two structural design principles allow for the rapid alteration of spatial configurations to meet changing functional requirements.

(6) Dedicated spaces are held to a minimum and planned so that they adjoin common use areas and other dedicated functions. For example, in Figures 6-3 and 6-4, the large, sloped-floor classrooms are located next to restrooms and major circulation nodes. This practice consolidates the school's dedicated space and permits multi-use spaces to be arranged in bands, rather than in isolated blocks; this, in turn, maximizes the flexibility of remaining spaces. For the same reason, when two or more sloped-floor classrooms are required, they are located along the same side of the corridor (see Figure 6-4).

B. Form.

(1) Spaces are organized in conjunction with planned sequences of viewing positions. All designs incorporate recessed entrances and exits and locate common-use elements at these points. Corridors are widened at circulation nodes and crossways are glazed to provide views of landscaping and vistas.

(2) Spaces are organized so as to result in compact facilities. For efficiency of circulation and conservation of heating and cooling energy, the form of the individual buildings and of the total facility has been designed to be as compact as possible, consistent with functional requirements. All schools have been designed with double-loaded corridors (i.e., activity areas on both sides of the corridor) so that total school circulation area is held to a minimum.

(3) All the schools illustrated in this chapter are designed within the maximum walking distances (see paragraph 5-2a(3)).

(4) Structures are planned for future expansion. As discussed in paragraph 2-4b(2)(i), the designer must plan for the future expansion of the service school. Figure 5-11 illustrates one way in which expansion planning can be accomplished. Based on estimates of the educational mission and student load at future points in time, the school is planned to expand in three phases. In each phase of construction, the existing facility maintains its functional organization and is not significantly affected by construction activities. For example, there is no overhead vertical expansion which could seriously impair instructional programs on lower floors. Furthermore, each phase is designed so that upon its completion the school can adapt to a new functional organization quickly and easily. This is accomplished by expanding each functional element along its periphery in such a way that the total facility maintains a compact form.

C. Economy.

(1) The designs conform to a 5 foot by 5 foot planning module. All the designs employ rectangular building forms, modular construction, and common framing dimensions, and thus are simple to construct. Because of this, they can readily make use of off-the-shelf building system components (see paragraph 5-3a(l)).

(2) The schools are designed to minimize operating costs. All schools are designed as compactly as possible and are oriented along a North-South axis. This practice minimizes consumption of heating and cooling energy. Multi-story construction is utilized in the larger

schools to achieve compactness, but all schools are limited in height to three stories or less so that stairs can be used as the primary mode of vertical circulation. Furthermore, the circulation grid in each school allows a section of the school to be set aside for multi-use occupancy during all school hours. Designated sections of the school can be opened for use and the required entrances and exits maintained, while the remainder of the school is secured. For example, in the 30,000 sq. ft. school, the half of the building on either side of the central entrance can be used; in the larger schools, any single section between circulation nodes can be opened during off school hours.

D. Time.

(1) Rapid Construction.
As discussed in paragraphs 3-2b and 3-2c, the illustrative designs employ simple rectangular spatial forms and common framing dimensions. This enhances the ease of construction and thereby reduces the amount of time required for construction.

(2) Planning for Expansion.
As discussed in paragraph 5-3c(2) the designer must plan for the future expansion of the service school. Figure 6-5 illustrates one way in which expansion planning can be accomplished. Based on estimates of the educational mission and student load at future points in time, the school is planned to expand in three phases. In each phase of construction, the existing facility maintains its functional organization and is not significantly affected by construction activities. For example, there is no overhead, vertical expansion which could seriously impair instructional programs on lower floors. Furthermore, each phase is designed so that upon its completion, the school can adapt to a new functional organization quickly and easily. This is accomplished by expanding each functional element along its periphery in such a way that the total facility maintains a compact form.

6-7 Utilities Requirements for Illustrative Designs

A. Mechanical Requirements.
The planning factors developed in this paragraph are based on paragraph 2-2h., General Planning Factors, and on the representative spatial organizations listed below. These planning factors are not for design of service school mechanical systems. Their function is to provide a quick estimate of mechanical requirements for initial planning and funding projections.

- A school of 30,000 sq. ft. (gross area) consisting entirely of classroom space and a small administration area.
- A school of 150,000 sq. ft. (gross area) consisting of shop and classroom instructional spaces in a 3 to 1 ratio and an administration area equal to 20% of the total school area.
- A school of 400,000 sq. ft. (gross area) consisting of equal areas of shop and classroom instructional spaces and an administration area equal to 25% of the total school area.

B. Electrical Systems.
Electrical system requirements will be based on the following:

(1) Lighting and Miscellaneous Power.

School	Allowances (watts/s.f.)	Total KVA
30,000 sq. ft.	5	150
150,000 sq. ft.	5	750
400,000 sq. ft.	5	2,000

(2) Mechanical Power
(Heating and Ventilation Only).

School	Allowances (watts/s.f.)	Total KVA
30,000 sq. ft.	2	60
150,000 sq. ft.	2	300
400,000 sq. ft.	2	800

(3) Mechanical Power
(Heating, Ventilation, and Cooling).

School	Allowances (watts/s.f.)	Total KVA
30,000 sq. ft.	8	240
150,000 sq. ft.	8	1,200
400,000 sq. ft.	8	3,200

(4) Total Load Summary.

School	Total KVA Without A/C	Total KVA With A/C
30,000 sq. ft.	210	390
150,000 sq. ft.	1,050	1,950
400,000 sq. ft.	2,800	5,200

(5) Special Equipment.
Considerations for electrical systems include providing power for heavy shop equipment, computer equipment, and other special items with large electrical demands. Requirements of this kind must be identified by the using activity as required by TM 5-800-3, Project Development Brochures. Special electrical demands such as these have not been included in the electrical system requirements.

(1) Water.
Cold and hot water requirements will be based on the following:

a. Flow Rates.

School	Cold Water/ Person	Hot Water/ Person
30,000 sq. ft.	0.75 GPM	0.156 GPM
150,000 sq. ft.	0.40 GPM	0.10 GPM
400,000 sq. ft.	0.25 GPM	0.065 GPM

Note:
1. Heating period hours for all schools: 4.0
2. Peak load hours for all schools: 2.0

b. Total Water Consumption.

School	Max. Flow	Cold Water Total/Day	Cooling Tower Make-up
30,000 sf	160 GPM	3,600 Gal	6 GPM
150,000 sf	300 GPM	11,250 Gal	10 GPM
400,000 sf	720 GPM	40,500 Gal	40 GPM

School	Max. Flow	Hot Water Avg. Flow	Total/Day
30,000 sf	30 GPM	25 GPM	750 Gal
150,000 sf	60 GPM	50 GPM	2340 Gal
400,000 sf	220 GPM	117 GPM	8425 Gal

(2) Sewage.
Flow rates will be based on the following:

School	Flow Rate	Total Flow/Day
30,000 sf	22.5 Gal/Day/Person	3,000 Gal
150,000 sf	22.5 Gal/Day/Person	11,250 Gal
400,000 sf	22.5 Gal/Day/Person	40,500 Gal

(3) Heating.
Requirements will be based on the following:

School	BTU/HR/SQ. FT.	Total MBH
30,000 sq. ft.	60	1,800
150,000 sq. ft.	50	7,500
400,000 sq. ft.	50	20,000

Note: Based on ambient temperature of 0 degrees F., D.B.

(4) Cooling.
Cooling requirements will be approximately 1 ton per 250 square feet (shop areas excluded):

School	Total Tons
30,000 sq. ft.	127
150,000 sq. ft.	325
400,000 sq. ft.	1,084

Note: Based on an ambient temperature of 95 degrees F., D.B. and 78 degrees F., W.B.

7-1 General.

A. Purpose.
This chapter outlines project development guidance and planning and design considerations for upgrading existing facilities. It also presents strategies for physical development, outlines preplanning decisions, and give guidance for siting and facility selection peculiar to projects that require the modernization and improvement of existing facilities for use by Army Service Schools.

B. Applicability.
This guidance will apply to a wide range of small-, medium-, and large-scale projects and should be used with the criteria and guidance for new construction contained in the preceding chapters. The guidance will typically apply to projects involving additions, alterations, conversions, or replacement of existing facilities. It will also apply to projects involving the relocation of existing facilities and be useful for planning projects requiring phased construction and overlaps in the design-build process. The guidance may also apply to alternative approaches for upgrading. These include: step-by-step total replacement projects; the acquisition or erection of specially designed portable or relocatable facilities; the addition, expansion, or conversion of existing facilities by building of new permanent facilities; or the lease/procurement of new or improved operations or office-type furniture and equipment. For example, a step-by-step total replacement approach might require functional activities to be temporarily relocated for a short time to unimproved but adequate facilities during each upgrading phase; for less extensive projects, gradual unobstructive improvement of facilities and equipment might be required while major functions continue to operate in the same place.

C. Factors Affecting Individual Projects.
When a project's constraints indicate the need to upgrade existing facilities, several administrative, budgetary, and construction factors must be considered. These include the condition of existing operations; type of existing construction; relative historic significance of existing structures; timing and character of modernization and improvement projects; appropriation for and funding level; approval procedures of relevant construction programs; and, at the local level, the budgetary priorities and scheduling constraints imposed by installation manpower and material resources limitations. For projects involving historic structures or districts, the guidelines in TM 5-801-1 should be followed.

D. Development of Project Options.
Modernization and improvement projects involve a wide range of design and construction constraints and opportunities; thus, the using service must first investigate and evaluate the suitability and effectiveness of many construction programs and upgrade alternatives. This assessment should be guided by pre-planning decisions that define the scope and magnitude of required improvements. These procedures, especially those concerned with pre-planning data and preliminary identification of improvement projects, can draw heavily on activities described in TRADOC Pamphlet 415-1.

7-2 Pre-Planning Decisions.

A. Basic Decisions.
The main objective of pre-planning decisions is to identify a strategy for physical development that will improve existing operations. The functional characteristics and physical condition of existing operations are the most influential factors. Thus, the requirements of these operations must first be estimated before selecting an approach. The following should be considered:

(1) The functional character of existing operations.

(2) The physical character of presently occupied space.

(3) The need for technical assistance in assessing potential for upgrade.

(4) The long-range desirability of project accomplishment.

(5) The availability of funds for project completion.

B. Functional Character of Existing Operations.
A pre-planning decision concerning whether upgrading is required usually depends on the functional character of current operations and how much the existing facilities limit their accomplishment. A review of the functional criteria given in preceding chapters should indicate how well the functional objectives of Army service schools are now being met. The using agency should make a simple but objective evaluation of current operations based on the project-specific functional and planning and design criteria and the general guidance contained in Chapters 2, 3, and 4. Functional characteristics of existing operations can be rated according to the procedures given below. The results will show, quantitatively, the level of operational effectiveness; when considered with factors that affect project urgency, they will reflect the need for upgrade relative to the operations' functional characteristics and physical condition.

(1) Rating Existing Operations.
Based on the planning criteria and functional objectives contained in Chapters 2, 3, and 4, a

quantitative rating of conformity to requirements should be developed for each functional activity. Low rating, nonconforming, or exceptional conditions must be documented as being below a prescribed standard. For example, the general characteristics and specific functions of current operations can be described in terms of their relative conformity on a sliding scale between 0 and 10, where 10 would show the highest rating of conformity and 0 would show nonconformity. However, where minimum standards are set by Army engineering and construction regulations, the minimum standard will be scaled at 5; 0 to 4 will be below standard and 6 to 10 above standard. Whole increments will be scaled at 10 percent above or below standard, 50 percent below standard will be zero (0), and 50 percent above will be ten (10). Specific features with performance standards should be rated. A general rating should be done for each functional indicator listed in Table 7-1.

(2) Format.
Table 7-2 shows a graphic format that can be used to apply the general method for rating existing operations. Using Table 7-1 as a guide, an aggregate rating can be achieved by applying the following qualifications to the rating for each indicator: fair, 6 or 5; poor, 4 or 3; and very poor, 2 or 1. The rating for each indicator listed in Table 7-1 is then multiplied by the number indicating importance immediately following the indicators. This number represents the relative importance of each characteristic in terms of overall operational effectiveness. The first three indicators have the most impact on Army service school operations, the second two are important for individual activities, and the last two are only generally important to overall operational effectiveness. Aggregate ratings will usually fall into the following categories: excellent ratings will be above 125, good ratings will be between 105 and 125; fair, between 75 and 105; poor, between 45 and 75; and very poor, below 45.

(3) Factors Affecting Project Urgency.
The project's urgency will depend on the scale and complexity of operations, the geographical field of operation, and the mission-peculiar requirements of each activity. However, such factors are not easily quantified; they must therefore be considered on a project-by-project basis. They should be evaluated with the rating of the indicators listed in Table 7-1 to properly determine a project's urgency. Ratings in Table 7-2 that show a low degree of conformity to functional and operational requirements should be given high priority for project accomplishment. In general, a conformity rating of below 4 for each indicator will usually be enough to show a need for considering urgent construction. When the individual rating of conformity for factors a, b, or c is 9 or less, accomplishment of the entire project should be considered urgent. Such projects will require immediate authorization under the proper military construction program. Field inspection indicates the need for some upgrading in almost all service schools. Even relatively small activities usually have special mission-peculiar requirements that are not met or that may need improvement. Generally, when low ratings are analyzed in terms of the physical character of facilities, the poor condition of existing temporary-type facilities will usually require an upgrade strategy involving either conversion of existing permanent facilities or construction of new facilities. Paragraph 7-2c below discusses the impact that the physical character of facilities has on choosing a proper upgrade strategy.

C. Physical Character of Facilities.
Table 7-3 shows upgrading potentials related to the physical character of facilities for nine hypothetical field conditions. The most important physical factor is the type of construction housing current operations. Where temporary construction is greatly deteriorated or deficient such that functional deficiencies are increased or cannot be corrected, complete relocation would be a proper physical development strategy. This might require either converting existing facilities or building new ones; in some cases, a combination of both might be needed. When the scale of operation is very large and the amount of converted space is less than half the total space required, totally new construction may be appropriate. Table 7-3 lists other construction classifications and existing conditions as alternate upgrading approaches. The appropriateness of each option will be determined by project requirements and by the extent and composition of individual functional activities requiring upgrade. In Table 7-3, the location of each example facility is considered to be either the most desirable or at least suitable in terms of maintaining effective service school operations.

D. Project Desirability.
Table 7-4 shows the comparative levels of project development required either to modernize and improve existing facilities or to build new facilities for Army service school operations having similar staff and space needs. The actual cost of new or improved facilities must be set according to procedures in AR 415-17. The desirability of individual rehabilitation/conversion projects will depend on factors affecting future needs, especially long-range physical development (see paragraph 7-3a below). In general, the initial estimate of the need for upgrade should be based on a review of an organization's existing and projected operations and functional objectives. Project desirability should be determined by the organizational and functional requirements given in Chapters 2, 3, and 4. The guidelines contained in Table 7-4 are for illustration only. Preliminary estimates should describe costs in

Functional Indicators	Weighted Value	Criteria Reference	Evaluation Procedure
Location	3	Refer to Chapter 2.	Evaluate the existing operational relationships to determine 1) wheter the functional and physical requirements related to the location of individual service schools have been observed, and 2) wheter the existing location allows for effective physical relationshps between Army service school operations and related functional activities.
Functional Activity Relationships	3	Refer to Chapter 4 for the general space organization principles and physical relationships requirements of individual activities.	The present organization of space should be evaluated to determine whether the proper functional relationahps exist.
Circulation	3	Refer to Chapters 2 and 4.	Evaluate existing operational relationships to determine whether the proper pattern of visitor/staff circulation will allow maintenance of functional integrity within major activity zones.
Climate Control and Acoustic Isolation	2	Refer to Chapter 3 and to individual space criteria in Chapter 4.	Evaluate existing operations to determine whether the special environmental and climate control requirements of functional areas and individual activities are properly provided for.
Flexibility	2	Refer to specific guidance and criteria contained in Chapters 2 and 3.	Evaluate existing operations to determine whether present conditions conform to flexibility requirements. Conditions related to spatial environment, functional areas, partitions, support systems, and physical adaptability are the most significant factors affecting the flexibility of existing space. Conditions related to equipment, furnishings, and surface materials tend to have less impact on flexibility. In most instances movable objects can be readily adapted or changed; fixed elements present more lasting constraints on long-term operational effectiveness.
Special Construction	1	Refer to Chapters 3 and 4.	Evaluate existing operations to determine whether special construction features typically required by Army service schools conform to the functional standards for individual activities and the regulations governing the standard of operations.
General Design	1	Refer to Chapters 2, 3, and 4.	Evaluate existing operations to determine whether the minimum recommended standards for functionally effective design have been observed. Primary and support facilities should conform to the minimum design standards relative to the existing scale of operations.

Table 7-1
Characteristics of Existing Operations.

	Functional Indicator	Characteristics of Conformity						
		Excellent	Good	Fair	Poor	Very Poor	Importance Factor	Rating
a.	Locational Considerations	9					3	27
b.	Functional Activity Relationships				3		3	9
c.	circulation and Security		7				3	21
d.	Climate Control and Acoustic Isolation				3		2	6
e.	Flexibility and Adaptability				2		2	4
f.	Special Construction Considerations			5			1	5
g.	General Design Considerations				3		1	3
		A	Aggregate Rating					75

Table 7-2
Example Rating of Existing Operations.

terms of the scope, complexity, and sophistication of upgrading requirements, including long-term and site improvements. Where the total project requirements estimate shows the need for expenditures above 50 percent of the cost of new construction, the feasibility of providing totally new facilities should be studied. Such studies should compare the anticipated short-, or intermediate- and long-term building and site upgrading costs. They should also compare the maintenance and operating cost of using existing facilities with the construction, maintenance, and operating costs of new construction.

(1) Feasibility of Large-Scale Upgrading. Table 7-4 compares upgrading costs to new construction costs to illustrate the feasibility of large-scale upgrade in terms of space and staff requirements. These costs are related to the gross area requirements for totally rehabilitated or converted facilities. The three points shown on the graph represent four example designs in Chapter 6. Space needs for each example are based on the requirements for a full range of functional activities provided within optimum physical relationships. By using a factor of 50 percent for allowable upgrading costs, one can predict both the feasibility of individual upgrading projects, and the possibility or desirability that new construction will be an acceptable upgrade option. The reverse of this type of analysis might help the using service determine the size and scope of activities that could be reasonably allowed for by existing space. Normally, it will be helpful; however, the structure of some service schools

/ Indicates likely options

(/) Indicates possible alternatives

Predominant Existing Conditions	Totally New Construction	Conversion				Rehabilitation						Repair & Maintenance
		First Priority Complete Relocation	Long-Term High Cost Upgrading	Second Priority Partial Relocation	Short-Term Immediate Improvement	Middle-Term Low Cost Upgrading	Middle-Term High Cost Upgrading	Long-Term High Cost Uprgrade	Long-Term Moderate Cost Upgrading	Middle-Term High Cost Upgrading	Short-Term Low Cost Upgrading	
1. Building and Site Deterioration and Deficiency (Temporary Facilities)	(/)	/	/	/								
2. Site Deterioration, Deficient Support Facilities (Temporary Facilities)		/	/	/	/							
3. Building Deterioration (Temporary Facilities)	(/)			/	/	(/)						
4. Building and Site Deficiency (Semi-Permanent Facilities)	(/)		/	/	/	/						
5. Site Deficiency (Semi-Permanent Facilities)				(/)	(/)	/	/	/	/			
6. Building Deficiency (Semi-Permanent Facilities)	(/)				/	/	/	/	/			
7. Permanent Facilities, Major Physical Development Constraints	(/)					/	/	/	/	/	/	/
8. Permanent Facilities, Minor Physical Development Constraints					(/)			/	/	/	/	/
9. Minimal Evidence of Existing Building and Site Limitations					(/)				/	/	/	/

Table 7-3
Upgrading Potentials.

or activities and the physical constraints and opportunities that are unique to conditions of each site and building tend to lower the accuracy of this means of using the guidelines.

(2) Partial Upgrading.
The need for partial new construction can be determined on a zone basis by identifying a few vital upgrade needs. For example, a first analysis of the upgrade requirements estimate may show that the need for new facilities will be limited to instructional shops or that major reconstruction will be required only in the training administration areas. Here, the service should try to do this as part of a larger program for total rehabilitation or total replacement. The percentages of the project shown in the example space allocations contained in Table 7-5 should be used for guidance. In general, upgraded space should have space allocations similar to new construction. Again, where 50 percent of new construction costs are exceeded by typical rehabiliation/conversion approaches, totally new facilities should be provided.

(3) Alternatives to Total Replacement.
When the need for relocation is identified and conversion of existing facilities seems most appropriate, at least two different partial upgrade options should be fully developed and studied before the final choice.

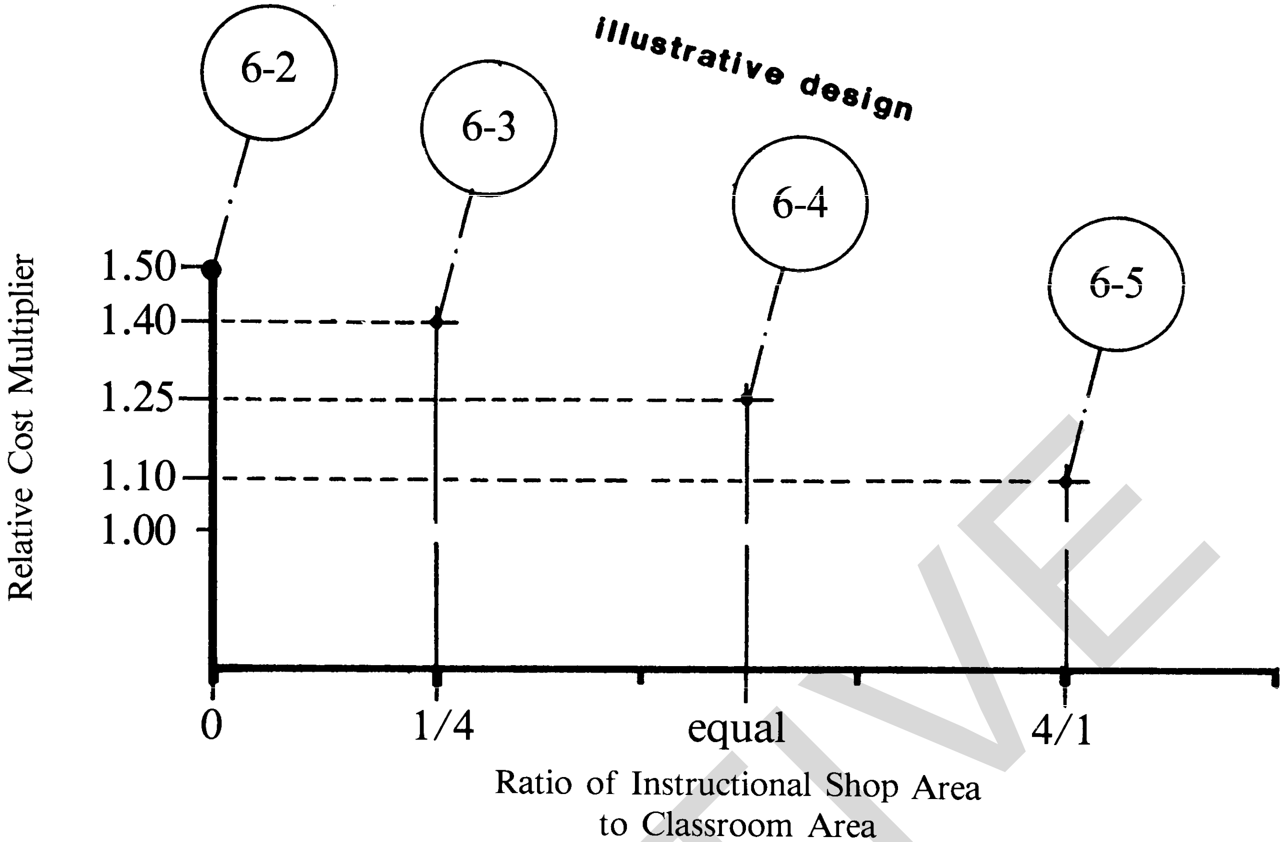


Table 7-4
Project Feasibility Guidelines.

Illustrative Design Ratio of instructional shop area to classroom area	6-2 30,000 sf 0	6-3 150,000 sf 1/4	6-4 150,000 sf 4/1	6-5 400,000 sf equal
Training Spaces	.81	.66	.81	.65
Training Support Spaces	.03	.06	.05	.03
Administration Spaces	.10	.17	.10	.25
Shared Spaces	.06	.11	.05	.07

Table 7-5
Example Space Allocations.

For example, one choice might emphasize interior changes in room layouts and circulation, and the other, exterior adjustments to building form. This should be done to evaluate the cost-effectiveness of upgrade options where the sites are similar or where location is not the major factor of the project's suitability. Options should consider expanding the inadequate space in buildings made mostly of substantial, permanent-type materials. Where there are enough options, converting spatially adequate but mechanically and structurally obsolete, temporary-type construction should not be considered. Where construction costs for an alternative to total replacement will exceed 50 percent of the cost of new construction, a third alternative must be considered: building a new facility. Also, where the square foot costs for partial upgrade, including relocations, exceed 50 percent of the square foot cost for a corresponding portion of new construction, the following should be considered:

a. The incremental development and ultimate replacement of existing facilities by building conventional, permanent facilities.

b. Acquisition of modular, pre-engineered facilities functioning concurrently with existing facilities as a short- or middle-term option.

E. Project Funding.
Completing upgrade projects depends largely on a careful rating of the various funding programs. Funds for constructing new facilities are typically authorized under and governed by major MCA programs and procedures. Funding for upgrade projects reflects a variety of characteristics connected with modernization and improvement projects. Funding limitations imposed by specific construction programs must be recognized when setting project priorities. There may be a large difference between actual upgrading requirements and the cost, type, and classification of modernization and improvement projects allowed under specific construction programs. Also, since the responsibility for approvals and the range of authorizations varies and since there are specific limitations to use of appropriated and nonappropriated funds, no single construction program or level and source of funding will always be acceptable for a given project objective. The following should guide project funding decisions:

(1) Program Limitations.
For small-scale upgrade projects, consider use of OMA funds authorized for maintenance and repair per local approval. This is very important where MCA program limitations severely limit funding resources or where certain physical limitations (a site or facility may not be available) may effectively reduce or prohibit carrying out some project objectives. Also, self-help improvement methods may be used for low-priority upgrading projects. Larger-scale projects with urgent requirements are usually given a high priority and would most likely be done under urgent minor MCA authorizations. In setting project priorities, it is important to note that use of urgent minor MCA funds requires a different approval procedure than OMA funding. It also has a higher authorization level; thus, most large-scale upgrade projects involving the existing facilities will be accomplished under minor MCA programs. This will allow the appropriate review of project requirements, and a final determination as to whether new construction might be more effective for achieving functional objectives.

(2) Program Characteristics.
A general review of the specific program characteristics in the AR 415 series (particularly ARs 415-15, 415-20, and 415-35), and the criteria in AR 420-10 governing maintenance and repair activities funding should be used to identify appropriate programs.

F. Technical Assistance.
When the using service must determine detailed mechanical and technical requirements, technical assistance will usually be sought from the local Facilities Engineer. The condition of existing mechanical, structural, and environmental systems may indicate a need for professional engineering assistance. This will usually involve preparing a preliminary evaluation of mechanical, structural, and environmental systems and the effect their physical conditions have on mission performance. This is very important for large operations and for those that foresee a need to greatly increase or improve present physical facilities over the long term. Sometimes, technical assistance may be needed to plan and design engineering systems accurately for substantial expansion of primary and support facilities. Extensive upgrade requirements, especially where new construction may be needed, will usually require specific technical expertise, such as mechanical engineering, structural engineering, site engineering, equipment and furnishing specification, or other specialized knowledge. Specific guidance follows on the main requirements for and sources of technical assistance.

(1) Principal Requirements.
Technical assistance is primarily required:

a. Where identifying functional requirements depends on accurately assessing the condition of mechanical, electrical, environmental, and structural systems.

b. Where complex cost factors must be identified and detailed estimates of long-range and life-cycle costs for building and site development must be accurate and reliable.

c. Where the need for extensive upgrading of environmental and mechanical services is already apparent.

d. Where cost estimates must indicate the extent that new facilities are competitive with the life-cycle costs and the potential use of newly modernized and improved facilities.

e. Where requirements for sophisticated technical, mechanical, and/or special operations-related equipment have been established, and procurement and installation schedules and standards are needed to assure proper use.

(2) Sources of Assistance.
The using service may ask for technical assistance from local installation planning, engineering, and construction services and from local communications-electronics personnel. Where local support is limited or not available, the using service may seek help from outside consultants. In all cases, the request for supportive technical or professional expertise should be processed by the installation DEH or by a Corps District Office.

7-3 Establishing Project Requirements.

A. Overview.
To properly establish modernization and improvement project requirements, the using service must consider specific programming, planning, and design factors that affect the physical development of existing facilities for use by service schools. As a minimum, this task should establish:

(1) The extent and character of upgrade needed for each functional activity.

(2) The appropriate building and site conditions relative to specific upgrade requirements.

(3) The impact on operations that might result from a specific sequence of upgrade actions or the particular priority assigned to project accomplishment.

B. Determining Individual Upgrading Needs.
The main planning decision that will influence selection of a proper construction program is determining the extent and character of individual upgrade requirements. In general, the extent of upgrade requirements is determined by organizing data gathered by analyzing existing conditions in terms of the short-, intermediate-, and long-range requirements of present or projected operations. How well facilities suit the needs of a service school activity at a given time should then be assessed. This can be done by comparing existing conditions and needs with the general functional and operational requirements and physical and environmental criteria contained here and in other relevant documents. Project location and existing primary and support facilities will largely decide upgrade options and needs.

(1) Project Location.
When the analysis of existing conditions or extent and character of upgrade requirements shows that operations should be relocated, specific site selection requirements related to project location must be set. New sites are usually determined by evaluating the impact of location factors on mission accomplishment. Thus, the using service should describe the most desirable location, stating the important factors to be considered in site selection. In preparing specific project location criteria, location factors that affect site selection should be arranged in two major categories.

a. Operational Environment.
The operational environment describes location factors to be considered when selecting which component areas or single activities will be included in the scope of upgrade needs. Future demand for and supply of essential support services provided either by a specific functional activity or by service schools operations in general influence components selection and the sequence of upgrade work. A description of operational factors affecting project location should indicate:

- The primary physical relationship to related functional activities.
- The main characteristics of adjacent activities.
- The main environmental characteristics of candidate sites.
- The functional characteristics of individual activities.
- The operational factors that significantly affect the physical requirements of existing operations.

b. Physical Environment.
A description of physical factors affecting project location should indicate:

- Accessibility.
- Circulation.
- Site features.
- Real property facilities.
- Surrounding land use and other man-made features.
- Site or building structures that might ease or obstruct upgrade.

(2) Primary and Support Facilities.
When an alternative site with primary and support facilities must satisfy functional requirements, the

Type	Requirements
Rehabilitation	Applicability: Upgrading facilities currently used for service school activities.
	Construction: Additions, expansions, extensions, and partial alteration, replacement, or relocation of existing facilities, and the permanent installation of equipment and facilities for functional purposes such as instructional shops or environmental and mechanical services, or for any other functional purposes requiring permanently installed equipment or facilities.
Minor Rehabilitation	Applicability: Minor rehabilitation is upgrading work that can be done in place. Construction: Surface treatments such as painting, lighting, or floor covering, furnishing or equipment, or the minor partitioning of space that requires no substantial alteration of primary building systems, constitute minor rehabilitation activities that could be done under local provisions for self-help projects.
Major Rehabilitation	Applicability: Major rehabilitation is upgrading work which involves the entire facility and requires extensive physical change. Major rehabilitation is the approach which should be considered when an analysis of existing conditions and an estimate of functional and operational requirements indicate that the total upgrading effort, considering long-term project accomplishment, will be cost-effective when compared to the costs of either converting or new construction. Construction: Major rehabilitation includes all activity described under the general type above. Depending on existing conditions, jaor rehabilitation may include either the temporary conversion of nondesignated facilities which are preferably adjacent or in close proximity to the currently occupied facilities undergoing physical and functional improvement, or the provision of temporary, relocatable, or portable buildings for required functional purposes within the time/use limitations of specific construction programs.
Conversion	Applicability: Conversion is the upgrading of an existing facility not presently used for functional purposes. Construction: Conversion includes construction activities similar to those referred to as appropriate for rehabilitation of existing facilities. The conversion alternative may involve the complete and permanent relocation of existing operations from one facility to another. It is usually required where adjacent facilities cannot be used with currently occupied space, and where contiguous physical and functional relationships must be maintained. The cost of conversion may be greater than rehabilitation-oriented construction and may exceed the 50 percent limiation relative to the cost of new construction. Both the cost and the availability of an appropriate alternative location for the permanent relocation of operations will be a determining factor choosing the conversion alternative. A study should be made of the feasibility of total new construction if dramatic changes can be anticipated after upgrading and, also, existing facilities present limitations on operational flexibility. Also, when alternate locations are not acceptable, the extended use of portable or relocatable facilities should be considered until the conversion of appropriate existing facilities is possible.
New Construction	Applicability: This alternate refers to either the total replacement of existing facilities with ground-up new construction or the partial replacement of existing facilities with the long-term view toward ultimate total replacement. New construction should be considered an appropriate upgrade option where cost-effectiveness and project feasibility studies show that it is economically and functionally more desirable than either conversion or rehabilitation of existing facilities. Construction: When considering the cost of construction, the 50 percent factor will be the main indicator of economic feasibility. While long-term functional and operational efficiency and the impact on mission effectiveness should govern the choice on a functional basis. This alternative includes: the conventional construction of permanent-type new facilities as an addition to or partial replacement of existing facilities, the construction or acquisition of modular-type facilities which are classified as semi-permanent or temporary construction and used for intermediate occupancy until either more adequate facilities or new construction funds are made available, the acquisition or lease of short-term relocatable or removable-type facilities such as pre-engineered or modular buildings, equipment, or mobile units. Urgent upgrading requirement for operations presently housed in deficient temporary facilities and having no immediate prospect of relocating to adequate existing facilities represent conditions where construction of totally new facilities would be most appropriate.
Conservation	Applicability: This approach generally refers to the repair and maintenance activities needed to conserve the effective condition of existing facilities. Construction: Conservation activities include minor self-help construction projects and the acquisition of furnishings and equipment that upgrade existing operations without requiring major adjustments in physical relationships or alterations to existing facilities.

Table 7-6
Potential Upgrading Alternatives.

Space Name	conservation	rehabilitiation	conversion	construction
Conference Classrooms	f/g	p/f	p/f	g/e
Laboratory Classrooms	f/g	p/f	p/f	g/e
Instructional Shops	p/f	p/f	p/f	g/e
Self-Paced Classrooms	f/g	f/g	f/g	p/f
Computer-Aided Instruction Classrooms	p/f	f/g	f/g	p/f
Seminar Classroom	f/g	f/g	f/g	p/f
Auditorium/Theater	f/g	f/g	p/f	g/e
Instructor Preparation	f/g	f/g	f/g	p/f
Instructor Rehearsal	f/g	f/g	f/g	g/e
Counseling Offices	f/g	f/g	f/g	p/f
Remedial Instruction	f/g	f/g	f/g	p/f
Technical Library	f/g	f/g	f/g	g/e
Study Areas	f/g	p/f	f/g	p/f
Projection Room	f/g	p/f	vp/p	vp/p
Administrative Offices	f/g	f/g	g/e	p/f
Conference Rooms	f/g	f/g	g/e	p/f
Student Lounge	f/g	f/g	g/e	p/f
Snack/Vending Rooms	f/g	p/f	vp/p	vp/p
Bookstore	f/g	p/f	vp/p	vp/p
Janitor	f/g	p/f	vp/p	vp/p
Storage	f/g	p/f	vp/p	vp/p

ratings:
e = excellent
g = good
f = fair
p = poor
vp = very poor

Table 7-7
Upgrading Requirements for
Individual Functional Activities.

facilities must be rated for their short-term, intermediate, and long-range potential to satisfy future physical development objectives. This is a primary requirement, since long-term operations continuity is essential to mission effectiveness. The site selection process should compare functional requirements to physical and operational factors like those described in paragraph 7-4a below.

(3) Potential Upgrading Alternatives.
Table 7-6 describes the main upgrade options that apply to modernizing and improving facilities for use by Army service schools. Used with Table 7-7, it provides guidance for determining the character of construction options. When combined with priorities set for project accomplishment, these options will determine the pre-design concepts and development strategies that satisfy the needs of selected functional activities. In general, identifying project priorities and setting pre-design concepts depend on consideration of the upgrade options described in Table 7-6.

(4) Individual Activity Requirements.
The specific type and number of activities that need upgrade will depend on how well they conform to essential functional requirements and minimum operating standards. The extent and character of upgrade needs for individual activities can be estimated with a method like the one for rating existing operations. Table 7-7 outlines the functional areas that may need improvement and the upgrading activities to be done. Following each functional activity are ratings of existing conditions which show the best upgrade option for a given field condition. In general, upgrade options depend both on a project's specific location constraints and on the condition of existing facilities.

C. Determining Building/Site Suitability.
For both buildings now occupied by service schools and those proposed as suitable for occupancy, the condition of existing buildings and sites affects both the accomplishment of project objectives and the provision of functional requirements. To properly decide the suitability of existing building/site conditions, the using service should evaluate each facility; they should then decide to what extent present conditions inhibit or enhance the short-, intermediate-, and long-term satisfaction of project objectives. See Sections 2-3 and 2-4 to determine the applicability of general functional and operational criteria to locational, building and site constraints, and project-specific requirements. In general, how well existing building/site conditions are suited to specific project requirements depends on the following factors:

(1) Building/Site Relationships.
The suitability of the location of facilities on a site depends on the physical development factors outlined in Table 7-8. The items show in Figure 7-1 give more guidance for determining building/site suitability.

(2) Building Size and Form.
The suitability of the building's size and form is very important to modernization and improvement projects. Since these characteristics must conform to the functional requirements of service school activities, a situation in which the building already conforms well will be most cost-effective. In general, the physical character and spatial pattern (height, length, and width) of existing spaces and the physical relationship needs of both individual functional activities and general functional areas (zones) must be considered together; this will allow the using service to determine how suitable a building's size and form are. The suitability of usable floor area and the number of floor levels will depend on the potential for satisfying the functional needs of a specific scale and intensity of operation. Thus, the suitability of building size will not be determined based on just gross area of aggregate space requirements as derived from generally applicable square-foot-per-person rations. The primary criterion must be functional effectiveness. Applying the functional space standards and principles of space organization in this guide will be important in determining suitability. Figures 7-2 and 7-3 show several physical constraints that should be considered in deciding the appropriateness of a building's size and form.

(3) Configuration of Existing Space.
In terms of allowing for functional needs of a particular scale of operation, the form of existing space will be a large factor in deciding the suitability of alternate facilities or sites. Thus, the physical characteristics and interior layout of existing buildings should be studied for their conformity to general space organization standards (see Chapter 4) and to specific operational needs. To properly access the relative value of space patterns in available structures, many possible layouts should be developed and studied to compare them to the size and form, interior partition layout, structural system, and circulation and fenestration pattern of an existing building. The examples of desirable field conditions provided in Figures 7-4, 7-5, and 7-6 show several space patterns and upgrade options. Table 7-9 lists concerns that should be used to determine appropriate space layouts.

Operational Characteristics

Requirements	References	Special Considerations
Each site should have the potential to satisfy: A. Specific operational needs. B. Proper physical and functional relationships, walking distances from Bachelor's Quarters, and cafeteria. C. Need for shared use of facilities (e.g., access road, parking, utility services), which will not interfere with essential functional requirements.	Chapter 2. Also see illustrative examples.	Consider existing and projected functional activities. Where existing facilities have or will have direct relationship to related activities, this will influence locational requirements of support facilities and site elements. If future operations require an increase greater than 50 percent of existing facilities, consider totally new construction.

Physical Characteristics

Requirements	References	Special Considerations
Each site should have; A. Potential to accomodate life cycle, usefulness, and utility requirements of current, and projected operations. B. Rectangular configurations; ample surrounding space for development. C. Site boundaries providing potential for future development not exceeding a 50 percent growth factor.	Chapter 2: Utility Support Criteria. Chapter 6: Requirement examples for different sizes of service schools.	Where configuration and space are inappropriate, there should be potential for expansion to adjacent sites for future adjustment. Avoid building and site shapes, topographical conditions, and site elevations which might inhibit provision and distribution of adequate mechanical utility services.

Table 7-8
Physical Development Factors.

Building Site Relationships

Requirements	References	Special Considerations
It must be possible to: A. Conform to established functional requireents. Building/site elements must be properly located and have adequate capacity to accommodate functional requirements. B. Provide proper building/site relationships. To potential for adequate site development must be apparent. C. Avoid potentially damaging or costly physical or climatological conditions. Over exposed facilities will have extensive HVAC maintenance, operations, and landscaping requirements. D. Provide unobstructed access for exapsion (pedestrian, vehicular) for two sides of existing facilities, so as not to limit future development options or impede accomplishment of separation of staff, visitor, and shop access essential to functional effectiveness.	Chapter 2: specific site development guidance	Where overexposure is already a constraint on operations, rehabilitation must provide protective landscaping to minimize operating costs. Extensive building perimeter caused by irregular building shape makes expansion of structural and mechanical systems difficult. Rocky and sloping sites also make expansion of relocation of existing utilities difficult and costly.

Adjacent Activities and Facilities

Requirements	References	Special Considerations
Consider functional character in terms of their relatedness to service school activities. Consider compatibility of physical and architectural characteristics of surrounding buildings with ultimate physical character of upgraded facilities. Consider building/site relationships on all sides in terms of access, site circulation requirements, and future development constraints and opportunities.		

Table 7-8 (Continued)
Physical Development Factors

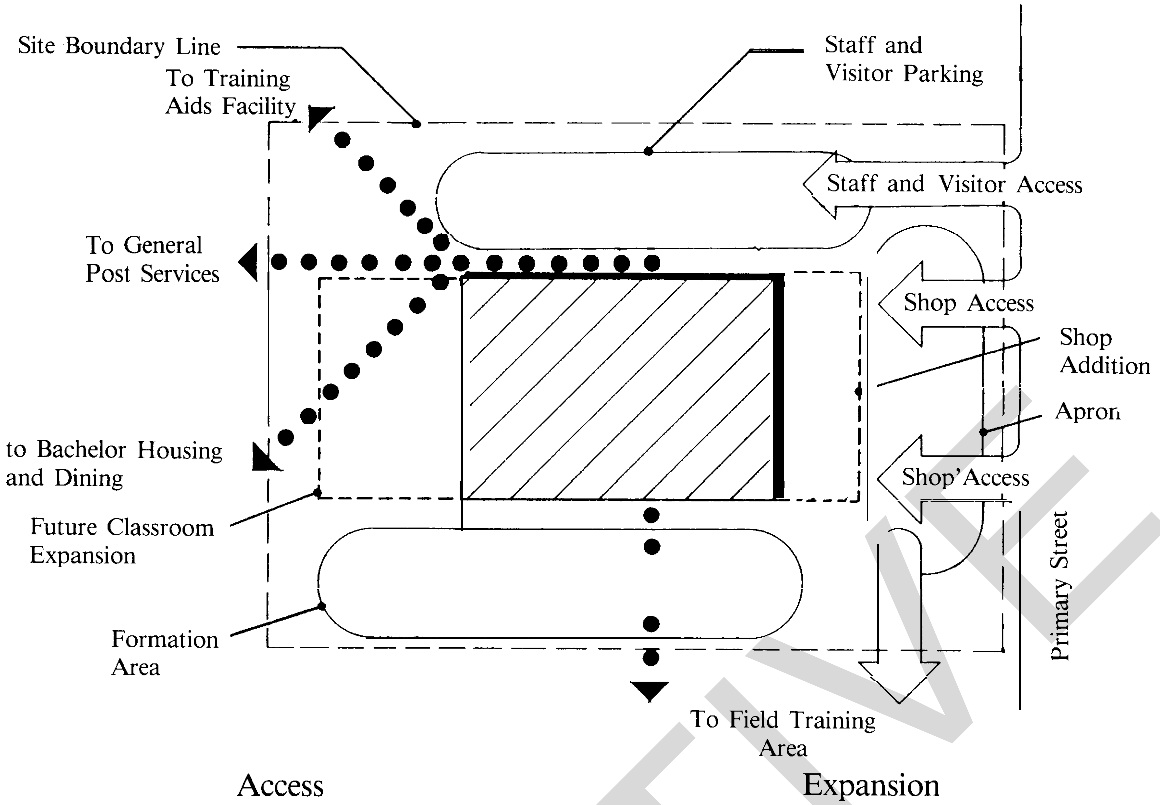


Figure 7-1
Typical Location Considerations.

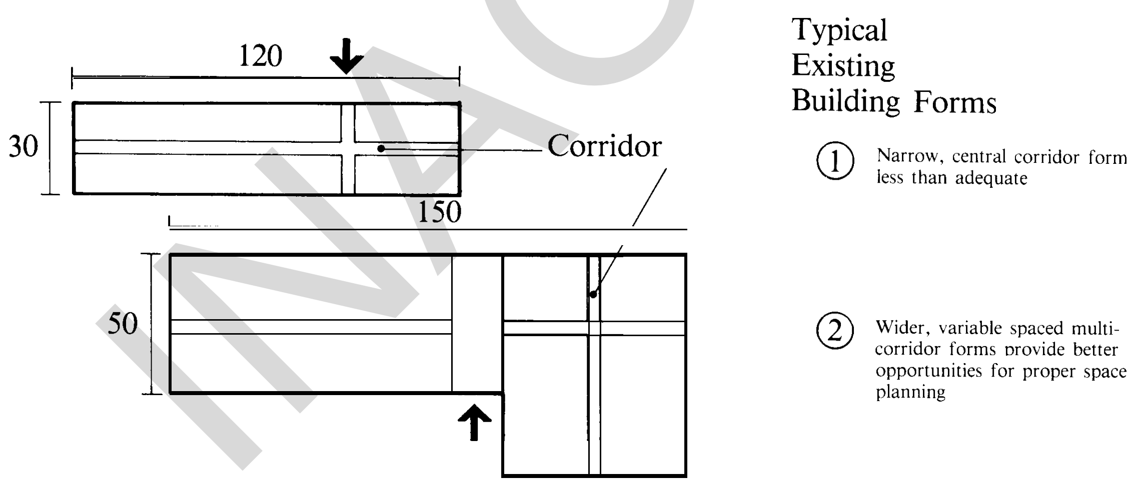


Figure 7-2
Typical Building Size and Form Considerations.

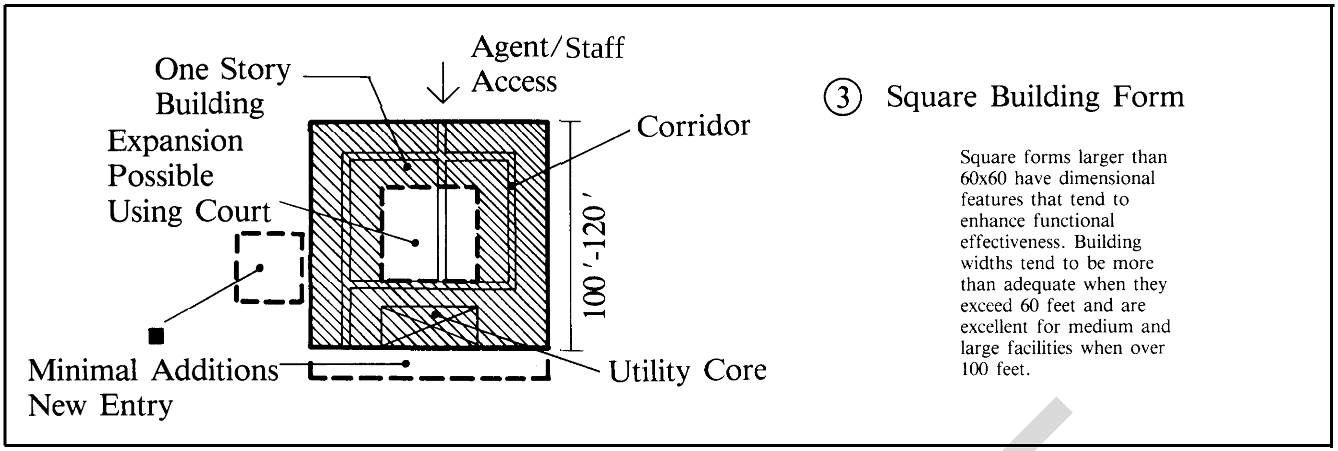


Figure 7-3
Square Building Size and Form Considerations.

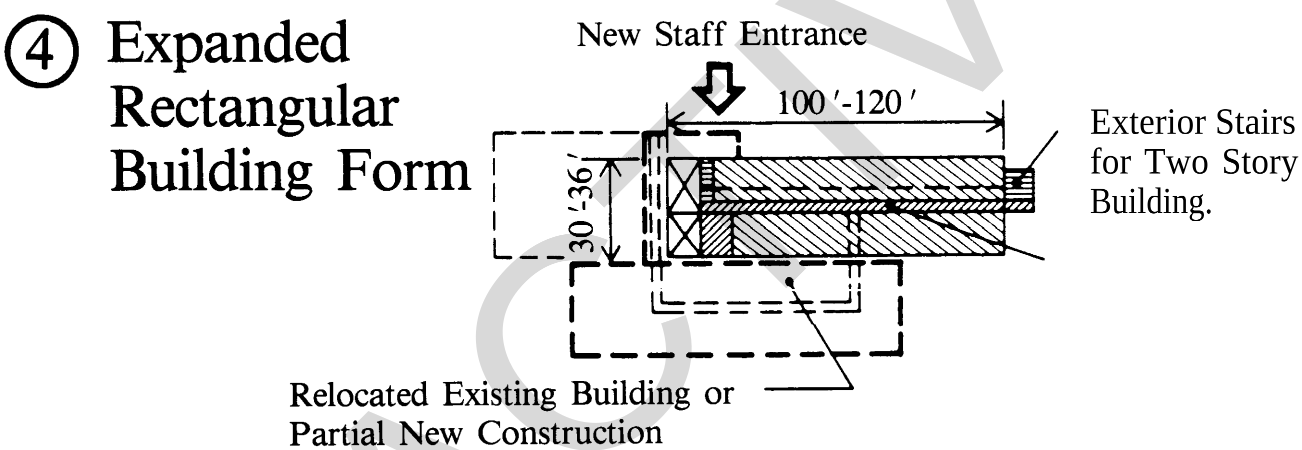


Figure 7-4
Expanded Building Size and Form Considerations.

D. Desirable Building and Site Conditions.
Existing buildings that are not adequate are not viable candidates for upgrade. These buildings should be avoided unless there is potential for either relocating other existing facilities or providing new facilities by partial construction; in all cases, adaptability of the existing building form, adequacy of floor area, and suitability of space patterns to the functional needs of service school activities are the desirable traits. Simple building perimeters normally will present few, if any, problems in completing upgrade objectives. Thus, irregular shapes have been chosen for Figure 7-7 to show the more difficult conditions that should be avoided in deciding how suitable an existing building or site is for service school use.

7-4 Establishing Project Sequence.

A. General.
Project sequence refers to the step-by-step order in which facilities are changed or upgraded to the desired standard of operations. To decide the sequence of modernization and improvement work, the using service must consider the impact of relocation or rehabilitation on the overall effectiveness of service school operations. When identifying project requirements, the using service should also consider the actual physical constraints and opportunities imposed by various upgrade options. Here, the using service should indicate the immediate and short-term impact that various construction actions may have on the on-going daily operations of Army service schools. The

⑤ Expanded Irregular Building Form

U, H, T, or + Forms

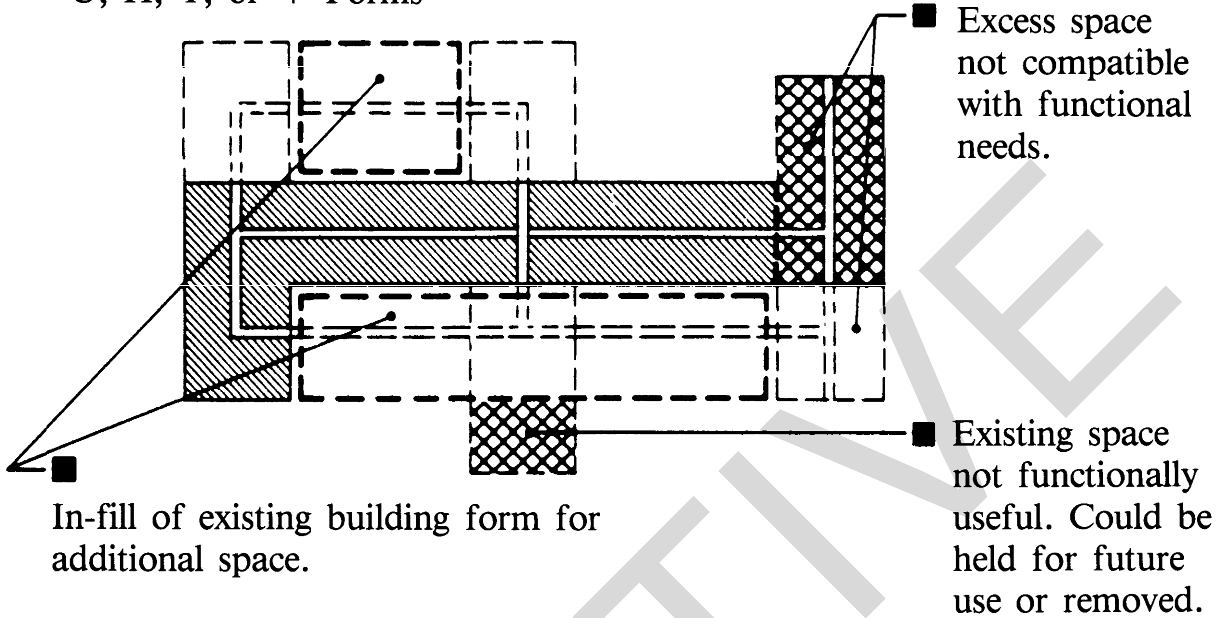


Figure 7-5
Expanded Irregular Building Size and Form Considerations

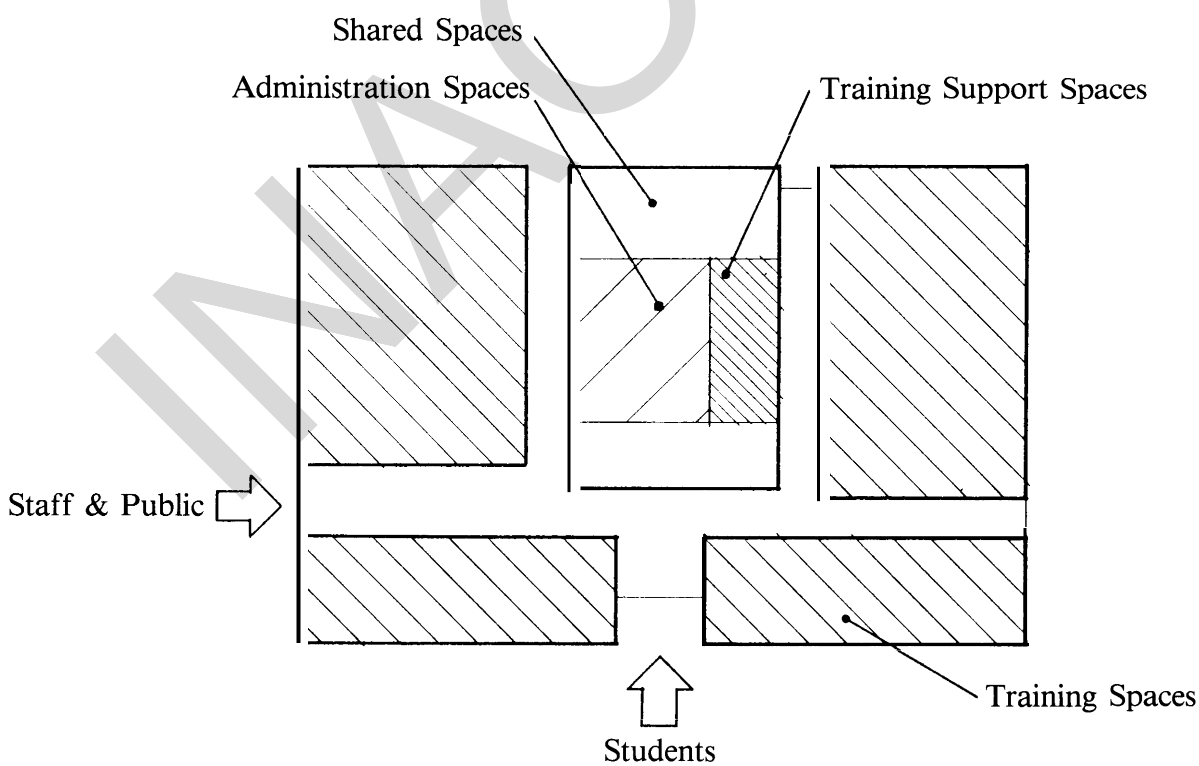


Figure 7-6
Desirable Space Configuration.

Items	Concerns
Space Adaptability	Physical characteristics which enhance cohesive nature of service school operations and administrative support spaces.
(a) Positive Opportunities	Simple building shape; building width-length between 50-100 ft., relatively open floor plan; circulation; access pattern which allows development of central corridor system.
(b) Negative Constraints	Building width under 30 ft.; limited access; off-set or irregular corridor; short structural spans
Mechanical - Structural	Most direct and effective means of distributing mechanical service; suitability; long-term usefulness
(a) Corridor Systems/ Perimeter Walls	Straight corridors, simple perimeter best suited to mechanical requirements
(b) Use of Existing System or Development of New Systems	Openness; need for incremental expansion; structural integrity; adequate ductwork and piping; capacity for supply of future electrical, plumbing services; technical assistance may be required here
Expansion	Future potential; adjustment, reorganization or relocation of relatively fixed position spaces, i.e., mechanical rooms, restrooms, instructional shops, and laboratory classrooms.
Space Partitions	Suitability ot project-specific requirements, compatibility with functional relationships and space requirements.
(a) Location	Avoidance of unnecessary impediments to expansion and flexibility.
(b) Large Open Spaces and Double Loaded Corridor	Less need for extensive interior renovation; reduction of construction costs
Circulation Patterns	Suitability
(a) Location	Future site and building access requirements
(b) Existing Interior Circulation Patterns, Location of Major and Mintor Corridor Systems	Relationship to major functional activities, to stairs, to visitor and staff entrances; separation of public, private, and confidential access
Outside Awareness	Visual privacy, natural light (location, potential usefulness, costs), direct fresh air
(a) Existing Features: skylights, exhaust fans, windows, sky-lighted artiums, perimeter ventilation, interior courts, new wall fenestration locations.	Compatibility with essential functional requirements
(b) Too Much Ouside Awareness	Difficulty in upgrading vs. buildings with little or no fenestration
(c) Small, Permanent type Warehouses, Service Buildings in Good Locations	Prime for upgrading for instructional shop areas
Interior Flexibility	Interior flexibility is enhanced by combining relatively stable interior functional spaces and support and buliding service areas and locating them in or near existing or proposed interior fixed partition spaces. Also, by consolidating entrances and stairs with existing or proposed mechanical equipment space, which is located on building perimeter, vertical supply shafts can be easily expanded to supply either new or relocated functional areas or future additions.
(a) Location of Fixed Partition Spaces: mechanical equipment space, toilets, stairs, major and minor entrances and corridors.	

Table 7-9
Space Layout Checklist.

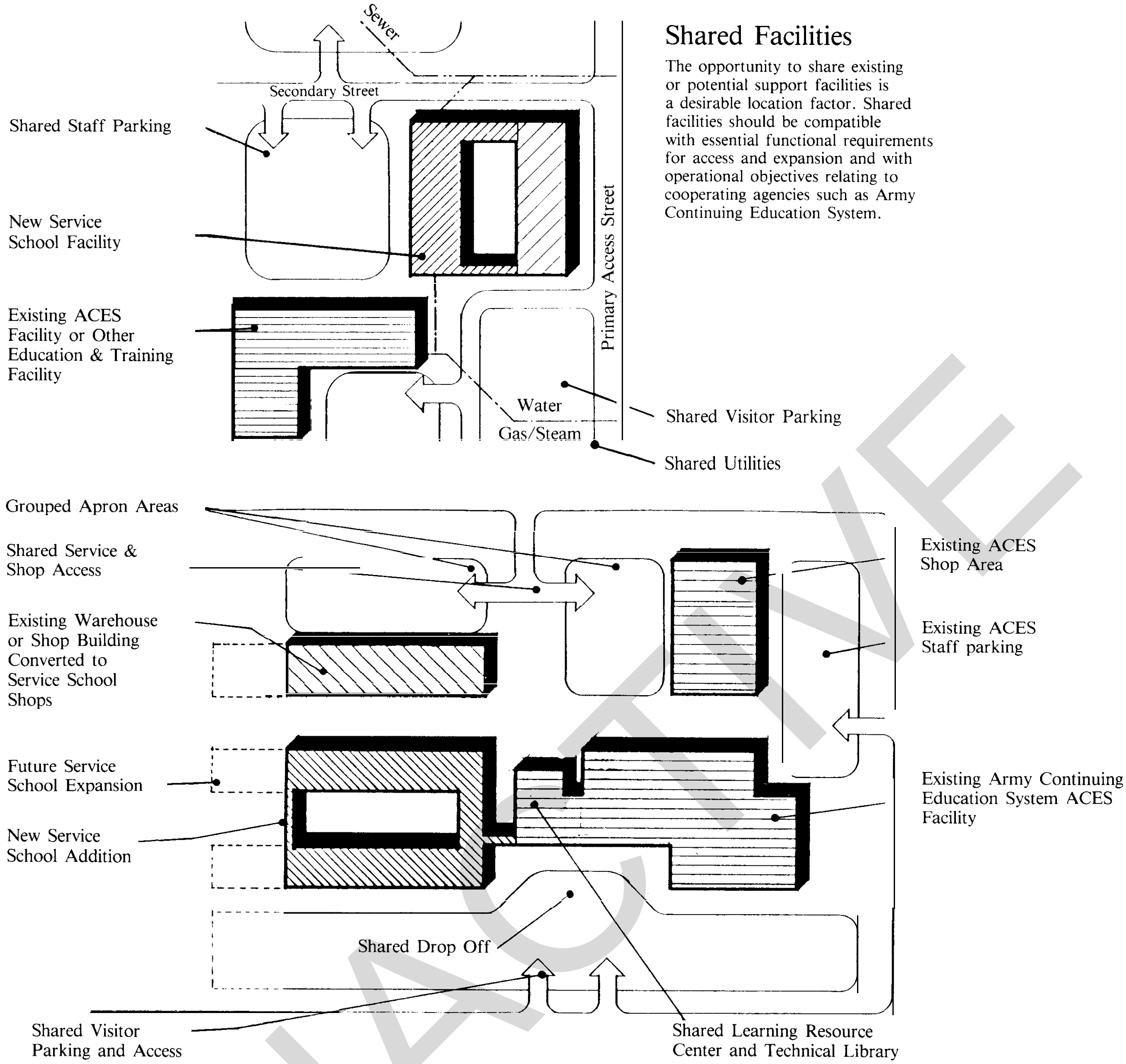


Figure 7-7
Building and Size Configuration.

space organization standards in Chapter 4 should be used with the following guidance to set up the proper sequence for upgrade.

B. Concurrent and Conflicting Improvements. The impact of a predictable sequence of upgrade activities on daily operations will usually help produce a functionally effective space organization which fulfills both immediate and long-term functional needs. Interruptions caused by improving one or more activity areas may have a large negative impact on other, unchanged functions; the result is a general loss of effectiveness. To avoid these problems, relocation of on-going functions essential to effective operations should be considered as a first step where:

(1) Two or three concurrent upgrade activities may isolate or make ineffective a critical operation that does not need upgrade.

(2) The effectiveness of nearby or related activities can be decreased by extensive upgrade work, even though their present location properly relates them to either dependent or supervisory activities.

7-5 Special Design Guidance.

A. General.
The general planning and design criteria used to develop pre-design concepts for new Army service school facilities (Chapter 2) must be adjusted

somewhat to relate to the new projects. Sometimes, mechanical and technical criteria may require a local interpretation. If exceptions to criteria or requirements are needed, they should be identified before planning requirements are set. Exceptions to construction requirements that will improve or eliminate functional defects in an existing facility or site should be considered essential. Sometimes, exceptions may be needed to carry out long-range operational objectives.

B. Basic Guidance.
When fixing proper design concepts, avoid setting initial project constraints that might limit or impede the development of functionally effective facilities. For example, once a proper upgrade strategy is set up, such as either conversion or rehabilitation, avoid limiting design options. The proper combination of strategies and sequence of work for an upgrade option must be indicated. This is especially true where project or program limitations will require upgrade work to take place within a severely constrained time schedule. Here, project development guidance should include a well-defined set of step-by-step procedures for each upgrade option. These instructions might speed the design process by defining where specific upgrade options apply, such as conservation, partial renovation, and new construction, as well as conversion of unoccupied space. For example, step-by-step procedures might be needed for a physical development strategy that calls for expanding existing activities into adjacent found space by means of newly constructed intervening space. Such projects may require exceptions to specific construction criteria; for example, they might allow for planning new mechanical systems and utility services for substandard facilities which will not be upgraded immediately. They might also be needed for incremental development over an extended time for site requirements such as visitor and staff parking, vehicle and pedestrian access and circulation, and landscaping. Special design requirements for facility upgrade should be established only after the general design guidance and the criteria given below have been considered.

C. Special Design Procedure.
The using service is responsible for developing the specific background information, design guidance, and functional requirements needed to prepare pre-design concepts. Design procedures for rehabilitation/ conversion projects differ from those for building new facilities in that the using service has more flexibility in controlling how a project is done. However, this flexibility can be lost when design procedures do not provide for the full development of at least two or three alternative pre-design concepts for a given upgrade requirement. Technical help may be needed to develop such design options.

D. Pre-Design Concepts.
The following factors should be considered in developing pre-design concepts for modernization and improvement projects:

(1) Long-Range Upgrading Strategies.
The using service must always keep in mind that project limitations can endanger future expansion and flexibility. Such limitations relate mostly to short-term piecemeal authorizations for individual facility and site improvements. Also, budget limitations may inhibit the provision of project features that reflect the need for future long-term facility expansion. Cost increases for long-range projects and comprehensive planning must be considered as the main ways to avoid limiting future expansion and flexibility.

(2) Special Operational Relationships.
The physical development plans of these agencies often influence functional relationships to related activities such as Army Continuing Education System (ACES). For example, a relationship of a cooperative or supportive basis may lessen or prevent the need for certain upgrade programs, or may in effect determine the need for others. Opportunities to develop shared-use facilities or to provide functional help to certain activities should be identified before obsolete facilities are improved, especially where such opportunities may influence a facility's location.

(3) Exceptions to Construction Criteria.
Most project development procedures usually provide for exceptions to specific construction criteria. However, exceptions to generally applicable construction criteria or to local installation requirements for site planning and design should be sought only for projects whose main objective of achieving functional and operational effectiveness would otherwise be greatly threatened. In general, such exceptions will be made only after reviewing the merits of alternatives and the specific impact that adherence to governing standards would have on achieving essential project objectives.

7-6 Establishing Design Requirements.

A. Site Planning Considerations.
Project site planning requirements are established based on physical development objectives approved by the local using service. Generally, individual site planning requirements can be identified by a thorough survey of the existing conditions using project objectives and limitations as guidelines. However, basic project limitations may prevent the achievement of maximum site development standards. This is especially true of rehabilitation work on facilities occupied by service school activities. Location constraints usually prevent major changes to the layout of existing site elements.

separation. Increases in the minimum separation distance might be required where optimum locations are constrained by inappropriate or conflicting nearby activities that make the operational environment less effective.

(3) Visual Approach.
Persons approaching a service school facility by car normally view the building from an oncoming angle of 30 to 45 degrees, rather than from directly in front. This oblique view gives the proper advance identification needed for turning into the entrance drives. Thus, the location of existing or projected site elements such as parked cars, eye-level flowering trees, or groups of evergreen plantings that might obscure views of signs or activity indicators either should be avoided or removed. Also, groups of trees should be selectively thinned and pruned.

(4) Access.
Setting design requirements for access points will depend on the character and intensity of operations as fixed by pre-planning decisions and on the site-specific development opportunities identified during site selection. Generally, vehicle and pedestrian access to existing rehabilitated or converted facilities must reinforce functional objectives. Site planning and building orientation factors should determine the proper design, location, and sometimes, the relocation and redesign of such site elements as access roads, on-site drives, parking, and pedestrian walkways. Refer to Chapters 2 and 4 for guidance on developing specific site planning considerations for various types of access, such as public, private, staff, and service.

(5) Site Circulation Systems and Parking.
Existing or redeveloped site conditions should allow safe, convenient pedestrian and vehicle circulation. Existing or redeveloped parking systems should clearly distinguish between various types of groups and individuals who might use the existing or converted facility. Desirable layouts of existing roads, parking, and walkways should be adopted only where they are consistent with fixed requirements for security and efficient operation and where they avoid locations directly over underground utilities. Redesign of pedestrian and vehicle circulation systems should conform to the guidelines in DA Architectural and Engineering Instructions (AEI) Design Criteria, TM 5-803-5, and TM 5-822-2. Specific site circulation criteria in Chapter 2 offer more guidance.

C. Landscape Planting.
The importance of landscape planting depends mainly on a site's physical characteristics and on the needs of each rehabilitation/conversion project. Budget limitations and priorities for physically upgrading a site will also influence the importance landscape planting has in project development. In all cases, however, landscape planting should be considered as a positive, effective, and sometimes essential way to accomplish functional and operating objectives. For example, the use of landscape planting is often an effective way to reduce heating and cooling requirements as well as related facility operating costs. Many landscape planting techniques can increase overall attractiveness and design image while providing confidential screening, weather protection, and sun-screening. The relative attractiveness of site access points, building approaches, and entrances to existing facilities usually influences appreciation and respect for the services provided within.

D. Site Lighting.
Existing sites and facilities may not provide for or conform to even the minimum site lighting requirements needed for physical security and operational effectiveness. Provision of adequate lighting for operations areas must be a high priority in rehabilitation/conversion projects. Generally, provisions for site lighting will depend both on the scope and extent of requirements for site and facility upgrade and on the level of sophistication allowed by project authorizations. Such provisions should conform to criteria given in Chapter 2.

E. Site Signage.
Upgrade of existing facilities can be improved by use of site signage. Where rehabilitation/conversion projects are mostly concerned with upgrading presently occupied space, site signage can greatly increase the control and separation of visitor traffic without major effort. Site signage and picto-graphic symbols should always be coordinated with interior signage systems for design and information consistency. Chapter 2 gives general criteria for site signage that may apply to rehabilitation/conversion projects.

F. Site Furniture and Equipment.
Rehabilitation/conversion projects will usually require two categories of site elements: site furniture and site equipment. Typically, these site elements are used to assist or increase the operational effectiveness of functional activities. Site equipment is an outside operational requirement that must be provided for where specifically identified. It includes: transformers, electric poles, mechanical vaults, various types of service school operational equipment, and utility meters. Items such as bollards, curb markers, relocatable signs, and other outside functional elements are considered site furniture. While there may be essential requirements for certain items in both categories, provision of site furniture for rehabilitation/conversion projects will be subject to a specific program's overall limitations and priorities. Initial site furniture requirements can be minimized by

Accounting for such constraints and limitations, every effort must be made to achieve the highest possible standard in improving site planning. Site elements which usually require improvement include major points of vehicle and pedestrian access, site circulation, and major overhead and underground utility lines.

B. Site Elements.
Figure 7-8 shows several areas of a site which need improvement, but on which little development should occur. The following site elements are important for the open space they represent:

(1) Easements.
Depending on the specific expansion and flexibility requirements related to individual rehabilitation/ conversion projects, the design and development of site elements which provide easement or dedicated areas should generally reflect the need for future building or site expansion. Existing landscaping or new site planning identified as a project requirement should not unduly obstruct the future development of dedicated areas. Easement should provide accent and interest. This can be done by planting low to medium shrubs next to either new or existing walk areas. Possible expansion of existing or future facilities may require relocating existing shrubs.

(2) **Buffer Zones.**
The general area next to the project boundaries should be designated as unavailable for construction. Buffer zones or setbacks are important site planning provisions that allow proper breathing room and separate an existing facility from adjacent uses. Preferred distances for rehabilitation/conversion projects should be as large as needed; they should consider the proximity of existing trees or other plants. Roadways and parking areas should be at least 20 feet from project boundaries. Single-story structures should be at lest 60 feet apart. Two-story structures should be at least 80 feet apart. Where one- or two-story structures are adjacent, they should be at least 70 feet apart. These minimum dimensions should be observed where functional requirements do not mandate greater

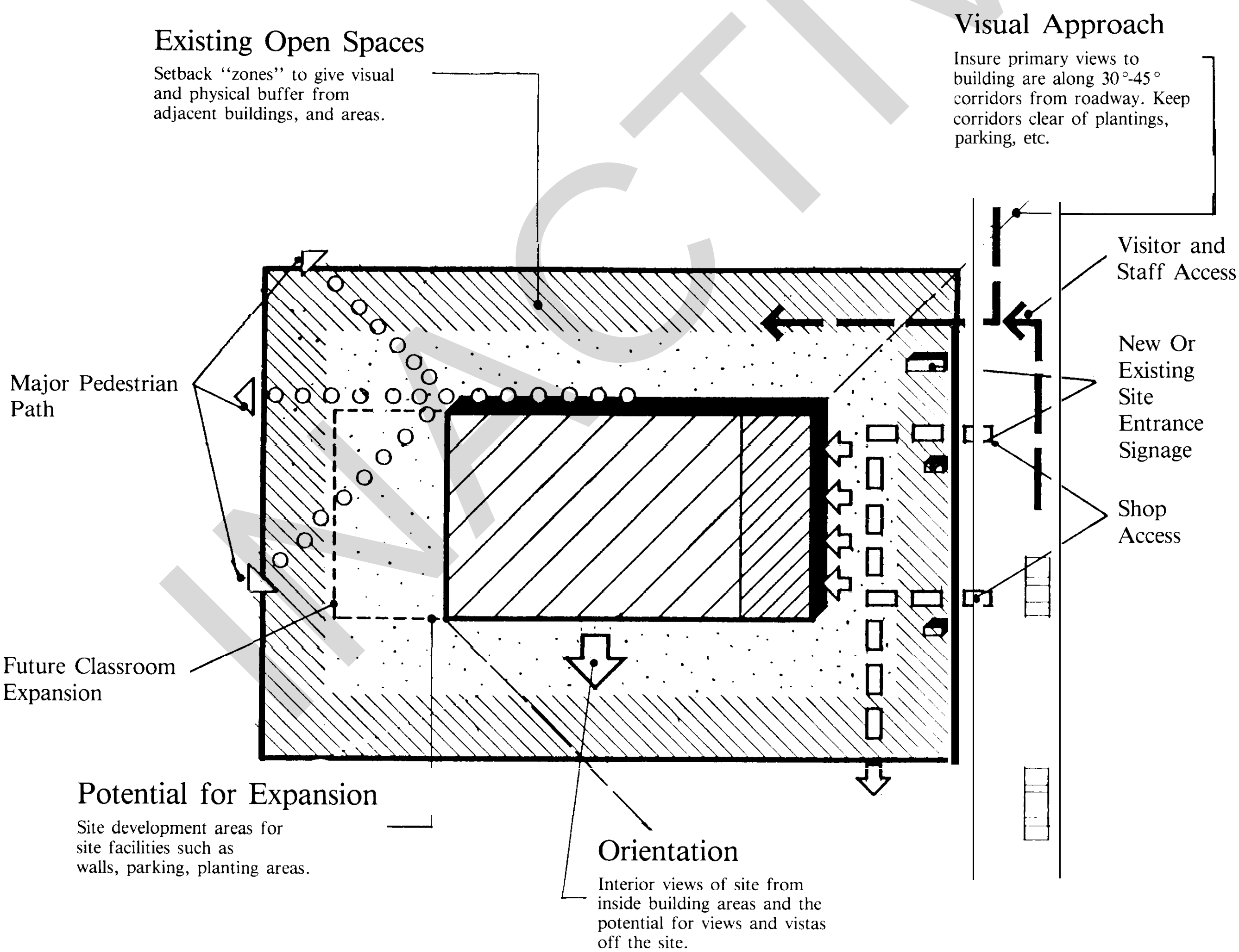


Figure 7-8
Site Elements.

re-using existing features or by using surface techniques such as pavement painting or changes in surface or ground material. This type of minimal requirement will generally occur where later upgrade will provide new site furniture. Provision of site furniture should be coordinated with other visually identifiable site elements. Project limitations may preclude acquiring new site furniture or require that existing items, which are adequate and otherwise meet basic functional requirements, be retained and upgraded. Where new and existing site furniture and equipment are combined, coordination of surface, color, and shape is important to establish a harmonious group of site elements. The scale and aesthetics of site furniture should be related to the materials, forms, and details used to upgrade the building.

G. Existing Utility support.
Existing site utilities should be able to support current and projected operational requirements. Local Facilities Engineering personnel will help the using service determine the site suitability of utility support. For the first estimate, the utility inventory report in the Installation Yearly Real Property Survey for a specific site for facility will be a reliable source of information. More utility support may be needed when preliminary estimates of building requirements are compared with available utility support. Probable requirements can be derived from the mechanical and utility requirements presented in the example designs in Chapter 6. Estimates of requirements for an entire service school facility should consider local variations in the design assumptions relative to orientation, climate, and the engineering value of various construction materials. Partial requirements for rehabilitation/conversion projects can be determined by factoring in the proportion of new construction requirements for upgrade. Where utility support is very inadequate, engineering studies will be needed to determine the magnitude of additional requirements. This is especially important if, all other factors considered, the site is still the best choice for service school activities. The main objective of such engineering studies should be to isolate the mechanical and utility needs directly associated with limited upgrading to compare costs. Engineering studies should also show the best way to provide the new mechanical and utility services. Utility support should always be provided so that future upgrade and expansion will not use obsolete utility systems or impair the effectiveness of adequate ones.

H. Relocation of Existing Support Facilities.
Locations of adequate utility and support facilities should not interfere with carrying out of rehabilitation/conversion objectives or providing essential building/site elements. Where the current location of utilities, roads, drives, sidewalks, paved terraces, or other support facilities would prohibit operational efficiency and the accomplishment of basic functional objectives, they should be relocated. Siting of relocated facilities should be shown on the rehabilitation/conversion site plan and should comply with currently accepted standards for support facilities.

I. Redesigning Existing Facilities.
Existing nondesignated facilities generally have an established architectural character, although it may not be appropriate to the architectural and functional requirements of service school activities. Specific functional requirements will be used to determine how inadequate a facility's design or space arrangement is. Specific functional requirements will also be used to determine the scope of required redesign and will influence the order in which the steps in the rehabilitation/conversion process are done. Environmental and interior design considerations, individual space criteria, and space organization rules should be evaluated to decide the specific redesign recommendations and work sequence in rehabilitation/conversion projects. The general design requirements for new construction in Chapters 3 and 4 offer more guidance for setting specific upgrade requirements.

J. Typical Field Application of Designs.
The description of typical field conditions in this chapter, and the example designs for new construction in Chapter 6 provide general planning and design guidance for rehabilitation/conversion projects. Functional requirements for a given scale of operations remain comparable, despite the physical conditions and facilities for which they were developed. However, the direct or exclusive use of example requirements alone will not adequately justify project-specific requirements. The general design guidance for new construction and the examples of new construction requirements will be the main source for project justification only when they are adapted to the requirements of existing conditions and used with appropriate upgrade options. The upgrading of existing facilities must always respond to the physical character, the planning and design constraints, and the limitations of each project. Upgrading may respond to needs in ways that reflect a more individual approach to physical development than is desirable for new construction; however, it should produce the same high standard of design.

Appendix

General guidance for color selection is provided in TM 5-807-7 and DG 1110-3-122. Colors, materials, and finishes should be chosen with an overall sheme in mind. Color should be used to stimulate human physical and emotional reactions and to enhance the building's overall functionality. Soft colors should be used in study areas and brighter base colors and accents should be considered for casual seeing spaces.

Glare, brilliant colors, and great brightness differences should be avoided in critical seeing areas, both in the lighting system and in the colors of walls, floors, furnishings, and equipment. Sample color and material finish schemes are shown in Figures A-1, A-2, A-3, and A-4. The samples have been arranged in a format which allows the overall color/finish scheme to be understood easily. See Table A-1 for color schemes for space types.

Figure A-1
Color Scheme A.

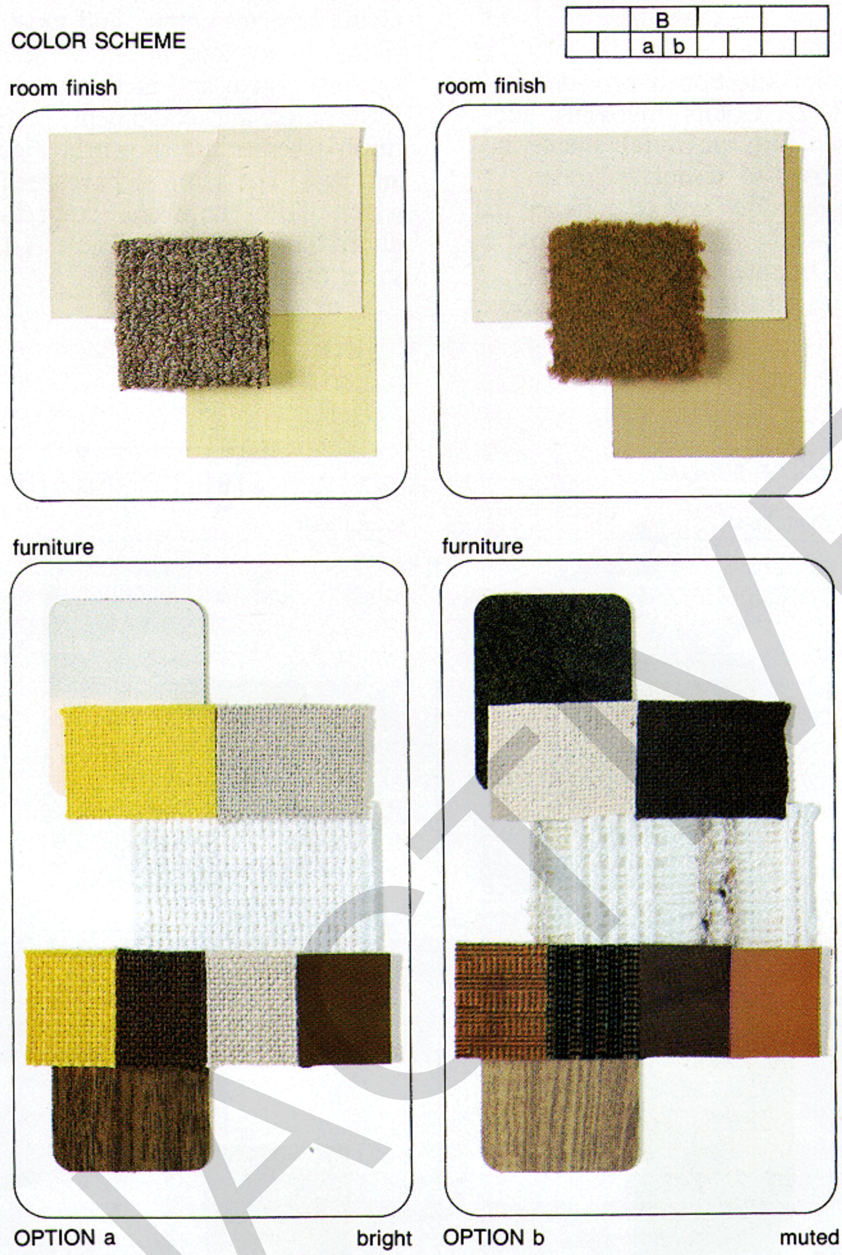


Figure A-2
Color Scheme B.

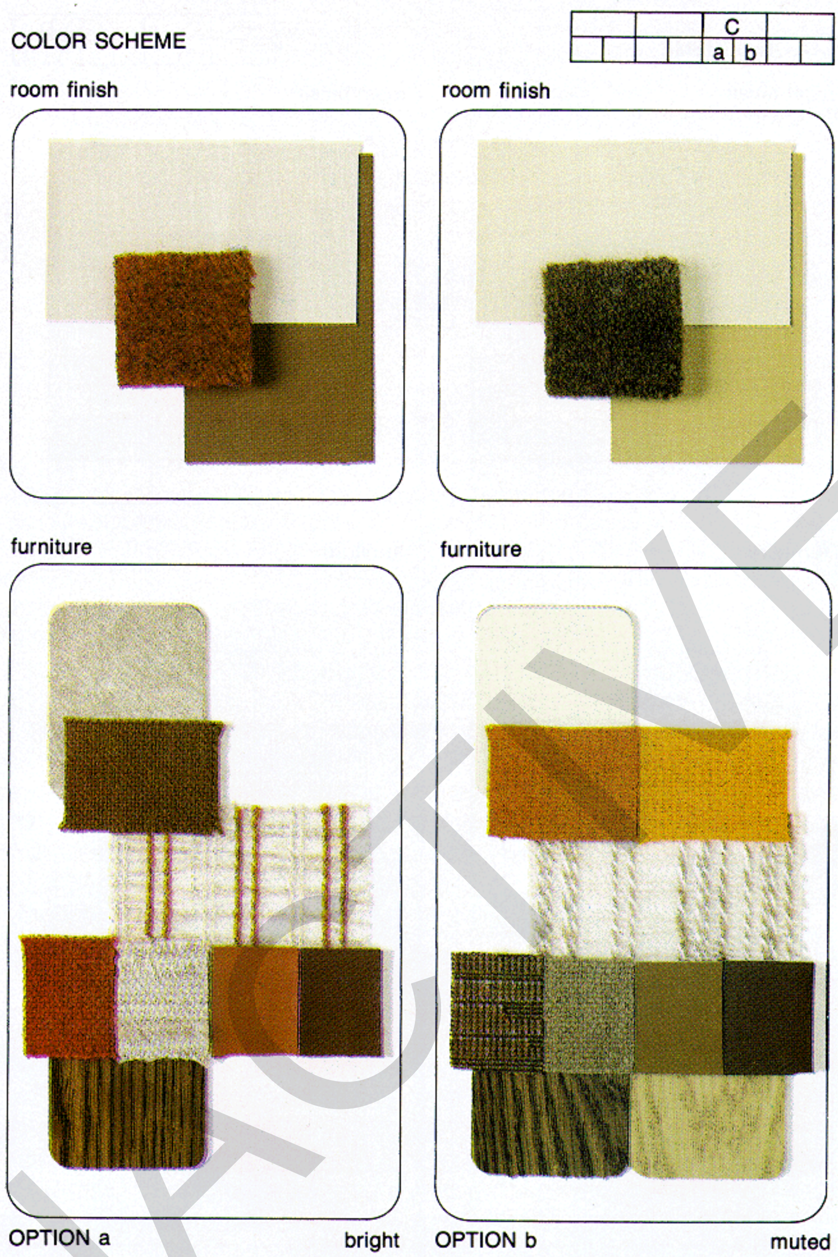


Figure A-3
Color Scheme C.

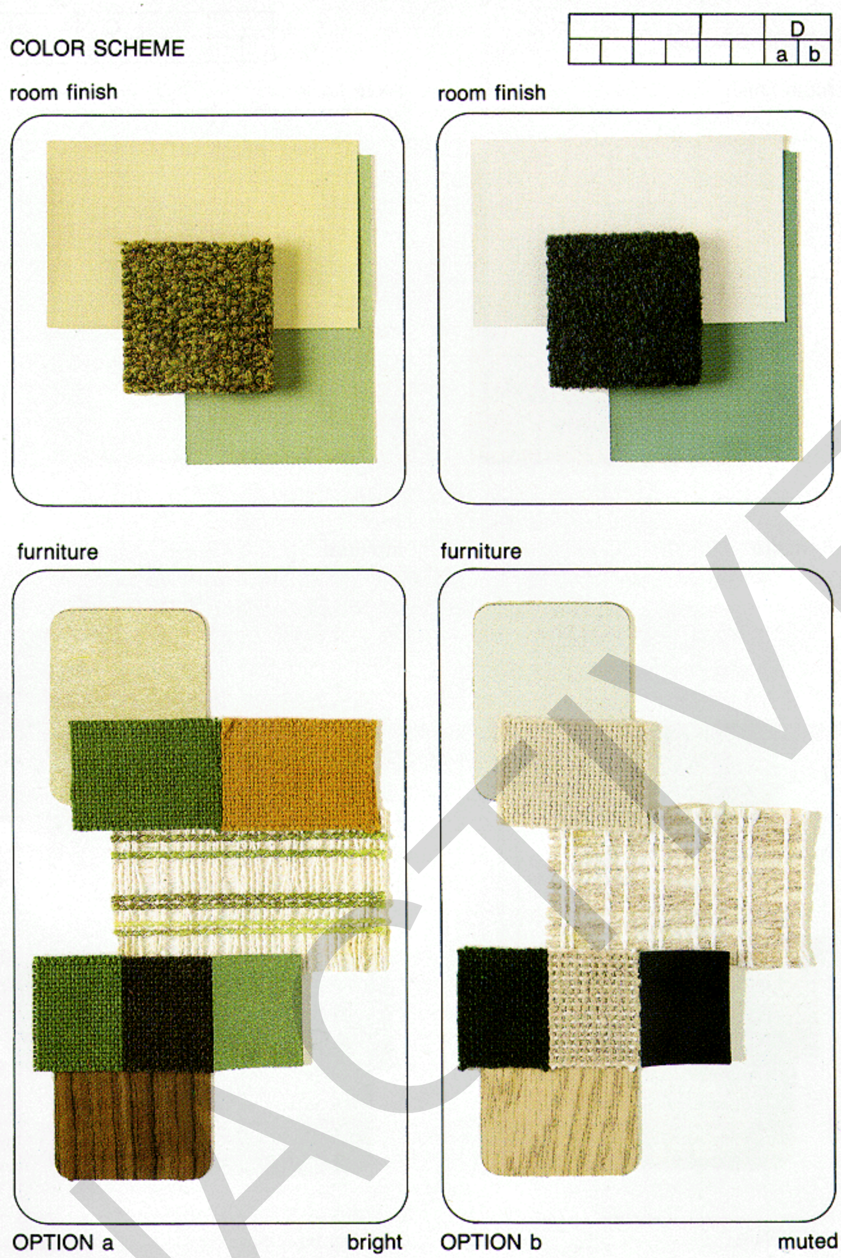


Figure A-4
Color Scheme D.

	A		B		C		D	
	a	b	a	b	a	b	a	b
Conference Classrooms		●	●	●	●			
Laboratory Classrooms		●	●	●	●			
Instruction Shops		●	●	●	●			
Self-Paced Classrooms	●			●		●	●	
Comptuer-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	–	–	–	–	–	–	–	–

Table A-1
Color Scheme for Space Types.

Selected Bibliography

The bibliography is ordered under the general topics of concern as follows:

A. Instruction spaces, including: classrooms, labs, shops, self-paced study carrels, and libraries.

B. School organization, including: planning guide, design for pedestrian movement, school siting, and landscape design.

C. Furniture and audio-visual equipment, including: furniture landscaping, projection AV, television, and the effects of student seating in the classroom.

D. Environmental requirements, including: thermal, lighting, acoustics, and the related concern of energy conservation.

E. Building systems, including: a comparative analysis of existing systems and a manufacturer's compatibility study of building systems.

F. Specific planing programs: planning and programing guides for specific vocational programs.

Each reference is accompanied by a short annotation to aid in directing information searches.

A. Instruction Spaces.

1. Beynon, John. Study Carrels: Designs for Independent Study Space. Stanford, Cal.: The School Planning Laboratory, Educational Facilities Laboratory, Inc., 1964.

   A sketch book showing many concepts of carrels, from the simple to the sophisticated. Includes some discussions of lighting, acoustics, visual privacy criteria, and component construction.

2. Educational facilities with New Media. Ed. Alan C. Green, 1966; rpt. Washington, D. C.: National Education Association, 1972.

   Essentially an architectural research report, primarily concerned with the designing of education facilities that are conducive to learning. Includes data, design studies, planning premises, reactions, and conclusions.

3. Hacker, Michael. "Architecture and the New Technology." Educ. Telev. Int., 4 March 1970, pp. 31-36.

   A discussion of the need for architects and school planners to design buildings which will allow for the optimization of the new instructional technology.

4. Libraries and Study Facilities: A selected Bibliography. Madison, Wisconsin; University of Wisconsin, ERIC Clearinghouse on Educational Facilities, 1970.

   Contains a selected reference list of publications of interest in the planning, programming, and/or design of library facilities. Sections included are library planning, carrels and study facilities, library automation and technology, resource and instructional materials centers, building equipment and materials selection, and additional references.

5. Toffler, Alvin, and others. Bricks and Mortarboards. New York: Educational Facilities Laboratories, Inc., 1964.

   This brings together information on what is happening in the four major types of campus building - the classrooms, the laboratory, the library, and the dormitory. Each section is written by a different person.

6. Woodruff, Alan P. Career Education Facilities: A Planning Guide for Space and Station Requirements. New York: Educational Facilities Laboratories, Inc., 1973.

   Discusses two classes of shared-space programs; that is, discusses spaces and equipment that can be shared by more than one program of a center devoted to career or occupational education. Covering more than the shared facilities, it is a comprehensive guide to planning for all the facilities likely to be encountered in career education.

B. School Organization.

1. Dobrovolny, Jerry. Factors to Consider in Planning Technical Education Facilities. Industrial Arts Vocational Education Supplement - Technical Education. TEI, March 1970.

   Discusses factors to consider in planning technical education facilities. Includes sections on component building systems, educational facilities, educational planning, flexible facilities, and technical education.

2. Fruin, John J. Pedestrian Planning and Design. New York: Metropolitan Association of Urban Designers and Environmental Planners, Inc., 1971.

Starting from a discussion of walking, the problems of pedestrians, traffic, and space characteristics of pedestrians are developed in sufficient detail for an understanding of pedestrian traffic relationships. The objectives of pedestrian planning programs and methods of plan implementation are illustrated. The design discussion is supplemented by illustrative examples.

3. Meckley, Richard F. Planning Facilities for Occupational Education Programs. The Merrill Series in Career Programs. Columbus, Ohio: Charles E. Merrill Publishing Company, 1972.

Extensive treatment of the subject of occupational education facility planning. Important planning steps from the initial survey of needs to the final building occupancy are included. Includes sections on (1) general principles and procedures, (2) a survey of community needs, site selection, and development, (3) financing the construction of facilities, and (4) post-secondary institutions.

4. Simonds, John Ormsbee. Landscape Architecture. New York: F. W. Dodge Corp., 1961.

A presentation of those facts, concepts, and principles of most value to architects and others concerned with environmental planning and with the siting and landscaping of buildings.

5. Taylor, Lieberfield & Heldman, Inc., Consultants. Horizontal and Vertical Circulation in University Instructional and Research Buildings. University Facilities Research Center Monograph Series, 1960-1961. Madison, Wisconsin: University Facilities Research Center, 1962.

A pilot study of the most severe pressure points in the area of circulation. Intra- versus inter-building time distance factors are considered and staggered scheduling is discussed.

C. Furniture and Instructional Equipment — Audio-Visual.

1. Caravaty, Raymond D. and Winslow, William F. Components for Rear Projection Systems. Establishing Criteria for Rear Projection Systems for Use in the Communication-Lecture Hall Centers, State University of New York. Troy, New York: Renssalear Polytechnic Institute, School of Architecture, 1964.

Rear projection systems and their requirements and limitations are discussed in the light of projection equipment, screens, the observer, and physical surroundings.

2. Dave Chapman, Inc., Industrial Design Office of Chicago. Design of ETV: Programming for Schools with Television. New York: Educational Facilities Laboratories, Inc., 1960.

A report on facilities needed to accommodate instructional TV and other new educational programs. Includes rationale for educational television, various ETV systems, relationships of size, quality, and height of teaching images to group size, viewing angles and distances, etc.

3. Hubert Wilke, Inc., Communications Facilities Consultants. "The Planning Disciplines for Audio-Visual Facilities." Architectural Engineering Special Report No. 14, Part 1. June 1971; rpt. New York: McGraw-Hill, Inc., pp. 137-144.

Discusses some of the specific design guidelines involved in providing for good sight and sound, and for the new concept of electronic distribution of full range of audio-visual media.

4. Propst, Robert. The Office - A Facility Based on Change. Elmhurst, Illinois: The Business Press, 1968.

A clarification of office functions, needs of the office worker and potential conflicts, and the introduction of the concept of generating, with furniture elements, office environments which respond to particular organizational needs and which are adaptable as needs change.

5. School Media Center. Toronto, Ontario: School Planning & Building Research Center, Ontario Dept. of Education, 1972.

This publication is intended to give guidance to those involved in planning new or expanded facilities for the school media center. Includes sections on controlled environments, instructional materials centers, and space classification and utilization.

6. Sommer, Robert. Effects of Classroom Environment on Student Learning. Davis, California: California University, Davis, 1965.

Investigating the effects of different classroom environments upon students. Seating positions within the classroom are considered as well as classroom furniture and overall classroom environment.

7. Wadsworth, Raymond. "12 No-No's in A-V Presentation." American School and University, August 1972, pp. 30-33.

Discusses problems with room size, room orientation, screen height, light leakage, elevated projections, loudspeakers, and electrical power systems.

D. Environmental Requirements (Heat, Lighting, Acoustics)

1. Berlowitz, Drucker, Scarborough. Thermal Environmental of Educational Facilities. Syracuse, New York: Syracuse University Research Institute, 1969.

   A presentation of information concerning the need for and the techniques of good thermal environmental design.

2. Bolt, Beranek and Newman, Inc. Sound Control Construction: Principles and Performance. Chicago, Illinois: United States Gypsum, 1972.

   Presents the basic principles of noise control in buildings and discusses the application of these principles in several commonly encountered problems. Contains sections on the nature of sound, room acoustics, and sound attenuation, plus a glossary of terms.

3. Griffin, C. W. The Economy of Energy Conservation in Educational Facilities. New York: Educational Facilities Laboratories, Inc., 1973.

   In the section on planning new schools there is a discussion of new construction techniques, such as compact building shape, multi-use occupancy, total energy, wall shading, automatic controls, improved mechanical design, and improved electrical design.

4. Jacques, Richard G. "Performance Criteria: A System of Communication for Mobilization Building Industry Resources." Architectural Record, 139, No. 5 (May 1966), pp. 191-195.

   Concerns a library of documents the New York State University Construction Fund is developing which pertain to a specific area of concern. Performance Criteria in work for NYSUCF at this time include: Acoustics, Lighting, Climate, Finishes, Disabled, Concrete, Aggregated, Site Products, Site Planning Equipment, Campus Planning Guide, Utilities Planning Guide, Facilities Planning Guide, and Design Vocabulary.

5. Kaufman, John E., Editor. IES Lighting Handbook Application Volume. New York: Illuminating Engineering Society, 1981.

   The technical handbook of the Illuminating Engineering Society. The book presents standards for both the quantity and quality of illumination required for specific visual performance.

6. Lang, Burnette, Moleski, and Vachon. Designing for Human Behavior: Architecture and the Behavior Sciences. Stroudsburg, Pennsylvania: Dowden, Hutchinson and Ross, Inc., 1974.

   An anthology of articles relating the concerns of behavior scientists to the process of architectural design. The book also contains a valuable reference bibliography.

7. Newman, Robert B. Laboratory Design Notes: "Acoustics in Research Facilities - Control of Wanted and Unwanted Sound." U.S. Dept. of H.E.W. - Public Health Service, May 1986.

8. Peters, John S. and Schneider, Raymond C. Improving the School Environment. Stanford, California: Stanford University, California School Planning Laboratory, 1956.

   Includes guidelines for creating improved educational environments, printed with supplementary drawings, diagrams, and photographs. Physical control functions are developed according to physical factors affecting classroom environment, meeting individual classroom needs, improved viewing conditions and mechanical system implementation. Functional design is explained in terms of criteria for changing school design needs and aesthetic functions.

9. Rutgers, Norman. Thermal Environments. Reno, Nevada: Nevada University, Department of School Administration, 1967.

   The role that a good thermal environment plays in the educational process is discussed. Design implications arise from an analysis of the heating and ventilating principles as applied to vocational-technical facilities. The importance of integrating thermal components in the total design is emphasized.

10. Sampson, Foster K. Contrast Rendition in School Lighting. New York: Educational Facilities Laboratories, Inc., 1970.

A report on lighting to determine how the contrasts in light from different sources affect the ability to see visual tasks in schoolrooms. Based on extensive field research, the report is concerned with the amount and the kind of light right for the best visual performance.

E. Building Systems

1. Adinolfi, Anthony G. and others. Interior Finishes: Floors, Walls, Ceilings. Albany, New York: State University Construction Fund, 1968.

An interim report giving performance criteria for interiors. Includes exposure criteria, space classifications, test methods, and procedures and standards.

2. Building Systems Information Clearinghouse. Newsletter, Ed. John R. Boice. Stanford, California: Systems Division, School Planning Laboratory, School of Education, Spring 1969.

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3. Benet, James and others. SCSD: The Project and the Schools. New York: Educational Facilities Laboratories, Inc., 1967.

A report on the School Construction Systems Development Project in California, the first school system-building project in North America. Includes sections on the components (ceiling and lighting, air conditioning, interior partitions, cabinets, and lockers), educational requirements, and performance specifications.

4. Industrialization Forum. Ed. Colin H. Davidson, University of Montreal, Washington University, St. Louis.

Industrialization Forum publishes research articles on the industrializing and systematizing of the building construction process. Each article published is cataloged by keyword for quick retrieval. IF's keyword system also refers to other publications of research on industrialization of building.

5. Building Systems Information Clearinghouse. Manufacturers Compatibility Study: Special Report No. One. Ed. John R. Boice. Stanford, California: Systems Division, School Planning Laboratory, School of Education, n.d.

This is the first edition of a catalog which provides specialized and comparable product information and reliable data concerning product compatibility for architects and school planners as a partial answer to needs not adequately covered in the area of systems building by existing manufacturers' data. This edition is limited to building products which could be used in a post-SCSD school building system.

6. Robertson, Claron A., Jr., and others. Facility Planning Module Analysis and Design for the Integrated Facilities System. Washington, D. C.: Planning Research Corporation, Volume III, Part 2, December 1969.

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7. Systems: An Approach to School Construction. New York: Educational Facilities Laboratories, Inc., 1971.

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8. Trost, F. J. and others. Higher Education Facilities Systems Building Analysis: Summary Report and Documentary Work Report. College Station, Texas: Architectural Research Center, Texas A&M University's College of Architecture & Environmental Design, 1971.

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F. Specific Planning Programs.

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Gives a total perspective of the sequential tasks involved in the process of program and facility planning. Includes chapters on principal planning activities, systematic plans, including PEAT networks and principal activities time sequence, plus a definition of terms and a selected bibliography.

3. Sitterlee, L. J. A Guide for Planning Facilities for Occupational Preparation Programs in Electrical Technology. Research and Development Series No. 24. Columbus, Ohio: The Ohio State University, The Center for Vocational and Technical Education, 1970.