4-1 GENERAL

4-1.1 CONCEPT: Any building can be conceptualized as composed of a group of subsystems, each of which performs a function. The design of these subsystems is the major determinant of the cost and performance of the building. The subsystems are, to some extent, interrelated and may share some functions. For example, the exterior wall or interior partitions may perform a structural function. Thus, subsystems cannot be evaluated and chosen completely independently of one another. By focusing attention, during the early stages of design, on subsystems rather than the building as a whole, issues and alternatives are clarified, and major design decisions can be made on an orderly and systematic basis.

4-1.2 SUBSYSTEM ALTERNATIVES: This section provides information on subsystem alternatives that are appropriate to the Army club facility. Subsystems are reviewed on a generic basis, unrelated to specific building design or geographic location. The information given will serve as a useful check list and guide for subsystem choice while the general configuration of the building is developed. The following subsystems are reviewed:

Structure
Heating, ventilating, and cooling
Envelope
Interior partitions
Ceiling
Lighting

4-1.3 SUBSYSTEM COST: For each subsystem, except structure, a cost index is provided that shows the costs of subsystem types relative to one another, within the same subsystem group. The cost index is not transferable from one subsystem to another. Structural costs vary significantly from one location to another and, in addition, the structure may share roles with other subsystems such as exterior walls or interior partitions. For this reason no comparative cost index is given for structure.

4-1.4 LIFE CYCLE COST: The design of facilities constructed under Military Construction Programs must consider the potential economic impact of suitable alternate subsystems and components over the life cycle of the facility. This will include alternate considerations in such selection areas as structural systems, story heights, exterior and interior finishes, interior utility systems, and power supply

systems. Application of a formalized life cycle costing technique, if applied in the fullest sense, requires that life cycle cost data on each alternate subsystem and component be developed and used in the analysis. Thus, it must include the initial construction cost; and the operating, maintenance, and custodial costs associated with each alternate over the functional life of the facility. The utilization of a formalized life cycle costing technique will require additional effort in the design phase beyone that based on conventional design procedures. The technique will be used to evaluate the life cycle cost advantages of alternates which have the greatest potential to improve quality and/or functional efficiency at equal life cycle costs; to lessen the life cycle cost at no loss in quality and/or functional efficiency; or to both improve quality and/or functional efficiency and reduce life cycle cost. A brief summary of steps necessary to conduct the Life Cycle Costing Analysis is shown below:

a. Development of a spectrum of candidate alternates.

b. Approval by District of design alternates to be studied.

c. Development of raw economic cost data for each alternate by the designer.

d. Analysis of alternates by life cycle cost methods.

e. Evaluating results of analysis and selection of design choices.

STRUCTURE

4-2.1 GENERAL: General principles of economy in the design of a building structure should apply to the design of club facilities. The diversity in range of total building sizes and individual space areas is such that each building design should be considered on an individual basis.

Minimum design requirements for structural design are established in DOD 4270.1-M, Section 6-3, and TM 5-809-1 through 11 series which identifies governing codes and service manuals and applicable specifications related to specific materials.

4-2.2 SPECIAL CONDITIONS: Additionally, recognition should be accorded special conditions that apply to a specific project location. Special conditions may include climatic considerations such as: wind loading, (including typhoons and hurricanes), snow loading, and permafrost (permanently frozen ground). Geologic conditions will affect the design of foundations, and seismic conditions are important special con ditions. These conditions are addressed in the design standards establi shed by TM 5-809-1 through-11.

4-2.3 DESIGN CRITERIA: The design criteria in Table 4-1 w ill require evaluation and determination for all club facilities based on the individual needs of each facility. Comments related to each consideration suggest issues that may dictate the definition of specific requirements.

Table 4-1 Structural Design Criteria

Design Criteria	Comments
a. Major material.	Determined by project architect or engineer. Important considerations include character of the region, the character of adjoining buildings on the installation, and the desired design image for the facility.
b. Planning module, horizontal.	This may be established by the wish to incorporate pre-designed subsystems within the building, e.g., ceilings, partitions, etc., which have limited modular adaptability.
c. Structural depth, horizontal members.	Governed by required span, loading, material , and the need to accommodate other components of the building within the structural envelope.

d. Live load. Roofs: Determined by use, geographic, climatic and seismic data.

Floor: (Figures interpolated from TM 5-809-1.)

Space	Load in p.s.f.
1- Entry	100
2- Dining	100
3- Bar	100
4- Kitchen	100
5- Ballroom/Multi-Use	125
6 Party Room	100
7- Recreation Room, Quiet	60
8- Recreation Room, Noisy	100
9- Administration Space	50
l0- Rest Room	50
11- Storage	125
12- Maintenance Space	150
13- Mechanical Space	75
14- Locker Rooms	75
Circulation Space	100

e. Span Ranges. Roof: Primary and secondary spans determined by occupancy requirements, and economy.

Floor: For upper floors, determined by occupancy requirements of the floor below, and by economy, e.g., spans of a second floor will be determined by first floor occupancy requirements to the extent columns can be tolerated, combined with appropriate economy.

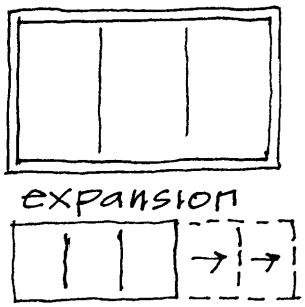
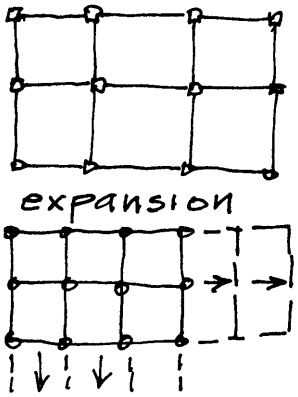
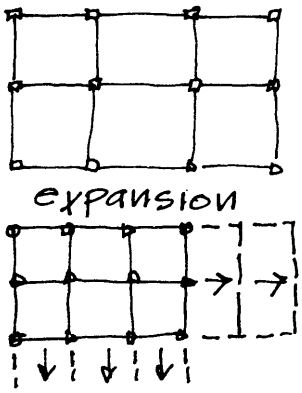
f. Most economical bay. Bay sizes will be determined by occupancy and the need to provide for change in occupancy.

9. Cantilevers. Determined by A/E design.

h. Vertical module. Not controlling, since most of these facilities are of single or two-story configuration.

4-2.4 BASIC FRAMING ALTERNATIVES: Three basic framing alternatives for one-story clubs are shown in Table 4-2.

Table 4-2 Structural Framing Alternatives

Vertical-Lateral	Horizontal	Comment	Basic Framing
a. Bearing and shear wall Wood, masonry concrete, braced steel	Deck/Beam, girder or truss: Wood, steel precast concrete	Structurally efficient system. Walls may double as exterior cladding. Does not readily allow for space expansion (one way only). Moderately heavy system.	
b. Two way rigid frame: Steel, concrete	Deck/Beam, girder Steel, concrete	Structurally efficient system. Requires separate cladding system. Flexible for space planning. Allows for two-way space expansion. Lightweight system.	
c. Cantilevered columns: Steel , concrete	Deck/Beam, girder or truss : Wood, steel, precast concrete	Structurally efficient system. Requires separate cladding system. Columns may be design element. Flexible for space planning. Allows for two-way space expansion.	

4-3.1 STANDARDS: DOD 4270 1-M, Chapters 8 and 9, establishes minimum acceptable standards for Heating, Ventilating and Air Conditioning (HVAC) systems designed for new club facilities and for the rehablitation of old facilities. Notes relating to preferred HVAC systems in club facilities are also included in DA PAM 230-1, Chapter 5, Sections 9-11, pages 5-6.

4-3.2 OBSOLESCENCE: Due to physical wear over the service life of equipment, and to the introduction of higher standards of code and performance criteria, many HVAC systems in older facilities do not provide an acceptable level of service.

In the selection of HVAC systems, consideration should be given to the long term implications for obsolescence as they affect performance and cost.

4-3.3 SYSTEM EXTENSION: In planning facilities for future change, recognition of the need for extension of a single HVAC system, or series of similar systems, should be made. For heating this may involve the provision of space for the addition of furnaces and air handling units to couple with the existing systems, or for the addition of elements of sectionalized equipment. In either event the controls should be mutually responsive and complementary.

4-3.4 CONTROL: Heating and cooling distribution systems should be designed to respond to varying contributions of heat gain and loss due to conditions external to the systems themselves. Notable causes of differential temperatures are solar heat gain through the fabric of the building, loss due to exposure to prevailing winds, and independent internal heat sources such as kitchen equipment, open fireplaces, and even body emissions in areas of dense occupancy.

4-3.5 NOISE AND DRAFTS. Complaints of excessive noise are generally attributable to excessive air velocities, poor positioning of air diffusers and return air grilles relative to the occupants, or to inadequacies in the attachment of the insulation of the duct system. The first two also contribute to discomfort due to excessive drafts.

While occasional compromises must be made in the rehabilitation of existing buildings, observance of new construction standards defined by DOD 4270.1-M should result in no deficiencies in new buildings.

4-3.6 SUB-SYSTEM ALTERNATIVES: A comprehensive description of generic systems for air conditioning can be found in the ASHRAE Guide and Data Book, Chapter 1.

For the purpose of establishing eligibility and other limitations on design criteria and weather zones, reference should be made to document DOD 4270.1-M, Table 8-2 and Table 8-3.

4-3.7 DESIGN ALTERNATIVES

4-3.7.1 Heating and Cooling: The following systems may provide heating only, cooling only, or both heating and cooling.

4-3.7.2 Central System Packaged Unit: Central system generally implies a single, central heating and cooling equipment location, which distributes heating water and chilled water to one or more air handling units. One central air handling unit may serve an entire building, or any major fraction thereof, i.e., one system per floor, etc. A packaged unit includes, as a manufactured assembly, heating, cooling, and air handling equipment. Such a unit may serve any fraction of a building.

4-3.7.3 Mixed Systems: A building may be served by one or more types of systems types, i.e., the perimeter of a building may be served by a fan coil or induction unit system, while the interior of the building may be served by an all-air type system.

4-3.7.4 Controls: Pneumatic, electric and/or electronic.

4-3.7.5 Heating and Reheat Coils: Steam, heating water or electric.

4-3.7.6 Air Outlets (diffusers, registers, grilles, etc.)

A. Configuration: Square, round, rectangular or linear.

B. Type: Adjustable or fixed louvers, blades, perforated plates, or slots.

C. Location: Ceiling, wall, floor, ceiling T-bar, or air handling light troffer.

4-3.7.7 Supplementary Heating Units

A. Energy Source: Steam, heating water, or electric.

B. Type: Convection, radiation, or combination.

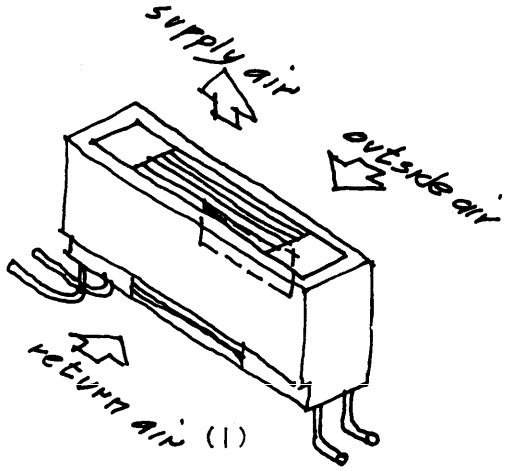
C. Location: Floor, ceiling or wall.

4-3.8 GENERIC SYSTEMS SUITABLE FOR ARMY CLUBS

4-3.8.1 Terminal Unit: Fan Coil and Unit Ventilator (1)

A. Description: The unit receives steam or heating water and chilled water from a central plant and outside air through wall louvers or from a central, ducted system. The unit has a fan, coils, and filters, and supplies warm or cool air to the room.

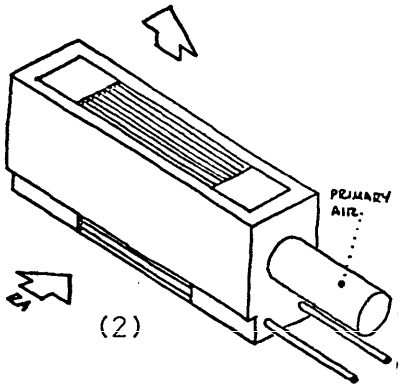
B. Types:
- two pipe, change-over
- three pipe
- four pipe



4-3.8.2 Terminal Unit: Air-water Induction (2)

A. Description: The unit receives high pressure, ducted, primary air from a central system, and induces room air. The mixture is supplied to the room. The unit has air induction nozzles and a coil.

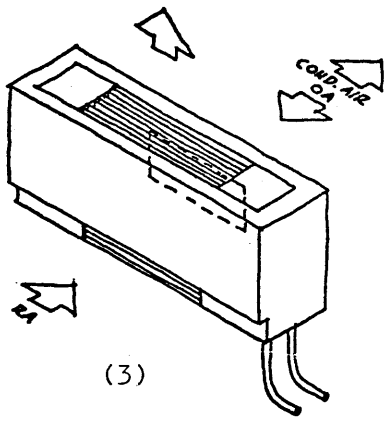
B. Types:
- two pipe, change-over
- three pipe
- four pipe



4-3.8.3 Terminal Unit: Self Contained (3)

A. Description: The unit contains an electric refrigeration unit, and may have either an electric or hot water coil.

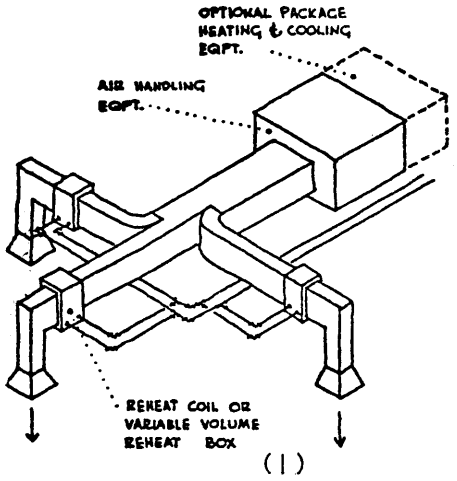
B. Types:
- thru-the-wall
- split system
- electric-hydronic



4-3.8.4 Single Duct: Air Water (1)

A. Description: A single duct from central air handling equipment delivers cool air throughout the building. Branch ducts from the distribution system, through terminal units, supply air to room air outlets, usually located in the ceiling.

B. Types:
- low velocity reheat- central system
- low velocity reheat - packaged equipment
- variable volume reheat - central system
- variable volume reheat - packaged

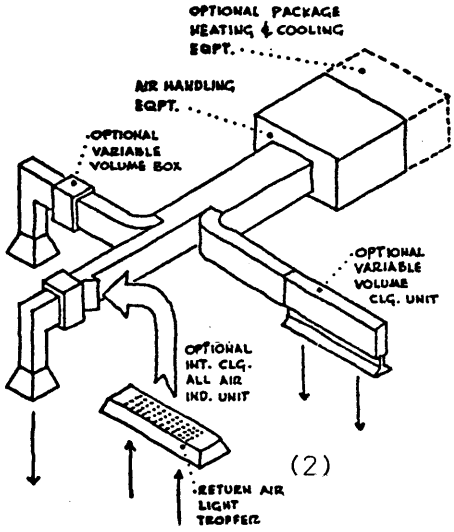


(1)

4-3.8.5 Single Duct: All-Air (2)

A. Description: A single duct from central air handling equipment delivers air throughout the building. Branch ducts from the distribution system, through terminal units, supply air to room air outlets, usually located in the ceiling.

B. Types:
single zone, central system
- single zone, packaged equipment
- variable volume, central plant
- variable volume, packaged equipment
- integrated ceiling, all-air induction, central plant
- integrated ceiling, all-air induction, packaged equipment
- variable volume, ceiling unit, central plant
- variable volume, ceiling unit, packaged equipment

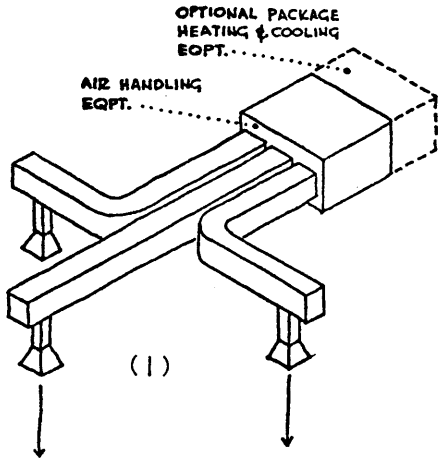


(2)

4-3.8.6 Multi-Zone (1)

A. Description: Each control zone has a separate duct from the air handling equipment to the control zone. At the central air handling equipment, warm air and cool air are blended by dampers to control the air temperature being supplied to the zone.

B. Types:
- central plant
- packaged equipment



4-3.8.7 Double Duct (2)

A. Description: From the central air handling equipment there are throughout the building, are a pair of distribution ducts--one with cool air and one with warm air. For each control zone, a branch duct is taken from each of the main ducts through a terminal mixing unit, and to the room in a common duct.

B. Types:
- low velocity, central plant
- low velocity, packaged equipment
- medium velocity, central plant
- medium velocity, packaged equipment

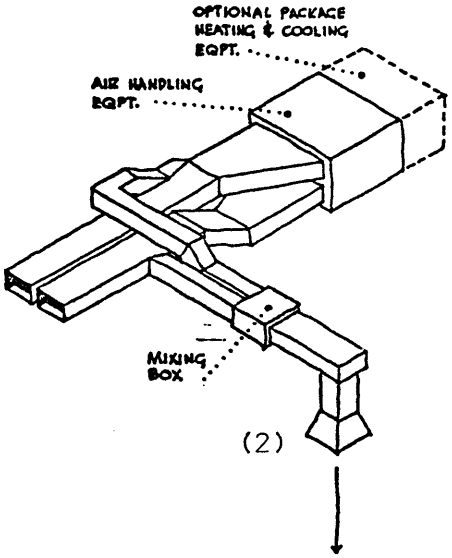


Table 4-3 H.V.A.C. Cost Performance Summary

		Cost Index(base 100) 1 high 2 low	Performance	3 Temp. Control	4 O.A. Vent	5 Air Distribution	6 Noise	7 OA/RA Control	8 Humidity Control	9 Cold Climate*	10 Dry Climate*	11 Adaptability	12 Durability	13 Economy Cycle	14 Heat Transfer***	15 Operating Cost**
Terminal Unit	2 pipe	130 110		-	+	+	+	0	0	+	+	0	0	N	N	+
Fan Coil	3 pipe	140 120		+	+	+	+	0	0	+	+	0	0	N	N	0
	4 pipe	160 140		+	+	+	+	0	0	+	+	0	0	N	N	+
Terminal Unit	2 pipe	110 90		-	+	0	0	+	0	+	+	-	0	Y	N	+
Unit Vent	3 pipe	130 110		+	+	0	0	+	0	+	+	-	0	Y	N	+
	4 pipe	140 120		+	+	0	0	+	0	+	+	-	0	Y	N	+
Terminal Unit	2 pipe	170 150		-	+	+	+	+	+	+	+	-	+	N	Y	0
Air-Water Induction	3 pipe	180 160		+	+	+	+	+	+	+	+	-	+	N	Y	+
	4 pipe	190 170		+	+	+	+	+	+	+	+	-	+	N	Y	0
Terminal Unit	thru-wall	140 120		+	+	+	-	0	0	+	0	0	-	Y	N	0
Self Contained	split systems	160 140		+	+	+	-	0	0	+	0	0	-	Y	N	-
	elec: hyd.	140 120		+	+	+	-	0	0	+	0	0	-	Y	N	0
Single Duct, Air water	L-V reheat (1)	160 140		+	+	+	+	+	+	+	+	+	+	Y	Y	0
	L-V reheat (2)	140 120		+	+	+	+	+	+	+	+	+	+	Y	Y	0
	V-V (1)	170 150		+	+	+	+	+	+	+	+	+	+	Y	Y	+
	V-V (2)	140 120		+	+	+	+	+	0	+	+	+	+	Y	Y	+
Single Duct, all air	single zone (1)	160 140		+	+	+	+	+	+	+	+	-	+	Y	Y	+
	single zone (2)	140 120		+	+	+	+	+	+	+	+	-	+	Y	Y	+
	V-V (1)	150 130		+	+	+	+	+	+	0	+	+	+	Y	Y	+
	V-V (2)	130 110		+	+	+	+	+	0	0	+	+	+	Y	Y	+
	integ. clg. (1)	190 170		+	+	+	+	+	+	0	-	+	+	Y	Y	+
	integ. clg. (2)	160 140		+	+	+	+	+	0	0	0	+	+	Y	Y	+
	V-V clg. (1)	150 130		+	+	0	+	+	+	0	-	0	+	Y	Y	+
	V-V clg. (2)	130 110		+	+	0	+	+	0	0	0	0	+	Y	Y	+
Multi-zone	central	160 140		+	+	+	+	+	+	+	+	0	+	Y	Y	+
	packaged	140 120		+	+	+	+	+	+	+	+	0	0	Y	N	+
Double Duct	L-V (1)	160 140		0	+	+	+	+	+	+	+	0	+	Y	Y	+
	L-V (2)	140 120		0	+	+	+	+	+	+	+	0	+	Y	Y	0
	M-V (1)	170 150		+	+	+	+	+	+	+	+	0	+	Y	Y	+
	M-V (1)	140 120		+	+	+	+	+	+	+	+	0	+	Y	Y	+

Notes: + = excellent
0 = good
- = poor
Y = applicable
N = not applicable

* As defined by DOD 4270.1-M.
** Includes energy, maintenance, replacement.
*** Indicates applicability of devices such as thermal heat pipe, rotary heat exchanger, etc.

4-4.1 GENERAL: Envelope refers to the combination of opaque and transparent materials that sheath the building exterior. The envelope may be entirely non-load-bearing or portions of it may form the vertical structure of the building. The envelope may be entirely fixed or portions may be movable in the form of operable sash or ventilation louvers.

4-4.2 FUNCTIONS: The prime function of the envelope is to provide a weatherproof, durable protection to the building exterior. In addition; the envelope provides insulation to the interior from outside ambient temperature and solar heat gain.

4-4.3 ENERGY CONSERVATION: The envelope is a major source of heat gain or loss to the building interior. Heat gain and loss must be compensated for by the air-conditioning and heating systems, and inadequate insulation or excessive solar heat gain through glass will result in greatly increased energy usage, and consequent operating cost increase. For this reason the extent, type and location of glass, and the proposed materials should be carefully reviewed with the mechanical engineer as design proceeds.

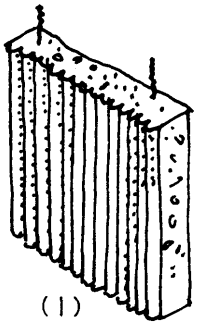
4-4.4 APPEARANCE: The envelope is a major determinant of building appearance. Besides the familiar attributes of form, color and texture, appearance is heavily influenced by maintenance. Materials that weather well and require little maintenance will be of overall benefit to the building appearance. Maintenance costs of all exterior materials should be carefully considered, not only as an aspect of life cost, but because high maintenance cost may result in insufficient maintenance of the building exterior and consequent deterioration of appearance.

4-4.5 ENVELOPE DESIGN ALTERNATIVES

4-4.5.1 Poured-in-place Concrete: (1) Usually performs a structural function. Finishes include:

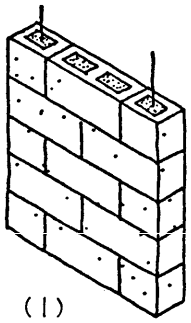
A. Integral Finish: Natural, exposed aggregate, bush-hammered, sand-blasted, flat, fluted, sculptured, etc.

B. Applied Finish: Masonry veneer, ceramic veneer, plaster, water proofing, painted surface, etc.



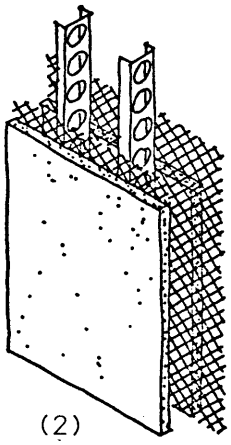
(1)

4-4.5.2 Masonry: May be structural. Can be single wythe or a grouted double wythe, or cavity wall. Masonry units can be concrete block, brick, structural glazed tile, stone, etc. A wide variety of surface finishes, bond and joint patterns, and unit sizes are available. (1)



(1)

4-4.5.3 Stud Walls: Use metal or wood studs, covered with a sheathing of cement plaster, or sheet materials such as plywood, hard board, or cement-asbestos board. Solid wood siding or wood shingles are also used. A variety of plaster textures are available, with color either integral or applied. Sheet materials may be factory or site-finished. (2)



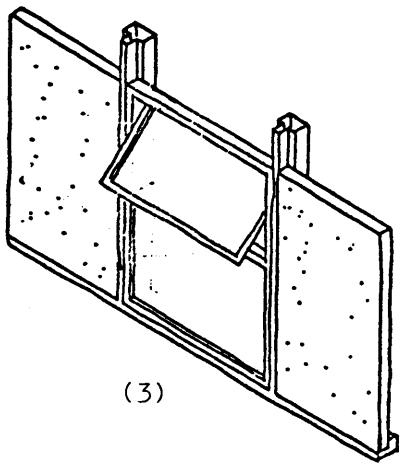
(2)

4-4.5.4 Curtain Walls: A wall assembly consisting of a metal mullion grid with infill panels of an opaque, translucent or transparent material. (3)

Mullion grid may be of aluminum, steel, stainless steel, bronze, etc. Infill panels may be single piece or composite panels with insulated cores and an inside and outside facing material.

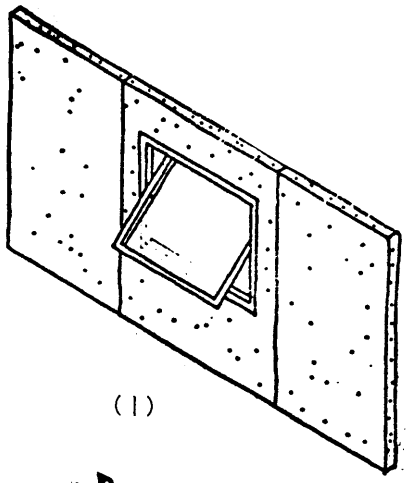
Opaque panels may be metal, precast concrete, plastic or assemblies of cement-asbestos board, gypsum board, hard board, etc.

Non-opaque panels may be glass or plastic mounted in fixed or operable sashes.



(3)

4-4.3.5 Wall Panels Subsystem: A wall assembly consisting of panels spanning from floor to floor, with no mullion grids. Panels may have voids permitting insertion of translucent or transparent materials or doors. Materials are similar to curtain walls. (1)

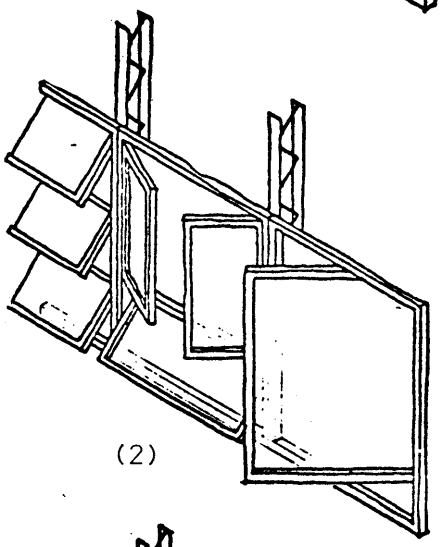


(1)

4-4.3.6 Operable Sash: May span entire opening from floor to floor or be a part of a curtain wall or wall panel system, or be inserted in a concrete, or rnasonry, or frame wall. (2) Materials may be:

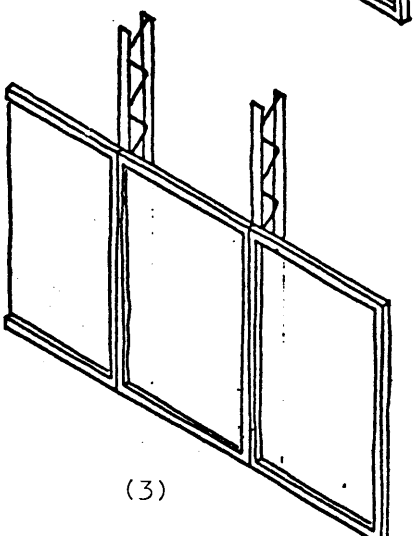
A. Sash Frame: Aluminum, steel, stainless steel, bronze, wood

B. Glazing: Plastic, sheet glass, plate glass, polished plate glass, clear glass, tinted glass, wire glass, safety glass, tempered glass, textured glass, sealed double pane unit, etc.



(2)

4-4.3.7 Fixed Sash: Nature and materials similar to operable sash. May also be directly attached to concrete or masonry walls, using neoprene gasketing. (3)



(3)

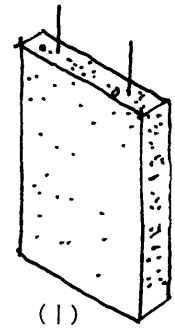
Table 4-4 Envelope: Cost/Performance Summary

			POURED-IN PLACE CONCRETE			MASONRY					STUD WALLS				CURTAIN WALLS				FINISHES							
		plain	brick veneer	cer. tile veneer	stone veneer	brick, 1 course	brick, 2 course	conc.blk 1 course	conc.blk.2 course	stone	glazed strct.tile	met. plaster	wood, plaster	wood, sheet mats.	wood, solid wood	curtain wall	wall panels	operable sash	fixed sash	concrete	integral fin.	masonry bonds	masonry joints	waterproofing	paint	met. integral	met. applied
Cost Index:	1. high		960	450	680	180	225	160	225	450	250	105	100	135	160	400	400	340	290		55	90	15	5	15	65	225
	2. low		310	400	590	160	180	135	180	180	200	100	90	110	140	250	250	270	250		20	0	0	0	10	50	190
Performance:																											
Durability:	3. poor													0													
	4. good			0								0	0	0	0	0	0	0	0				0	0		0	0
	5. excellent	0	0		0	0	0	0	0	0	0										0	0					
Appearance:	1. poor	0																									
	2. good							0	0		0	0	0	0		0	0	0	0		0				0		
	3. excellent		0	0	0	0	0			0					0							0	0			0	0
Insulation:	1. poor	0				0		0										0	0								
	2. good		0	0	0	0	0		0	0	0	0	0	0	0	0	0										
	3. excellent																										
Adaptability	1. poor	0								0																	
	2. good		0	0	0	0	0	0	0		0																
	3. excellent											0	0	0	0	0	0	0	0								
Adaptability to services:	1. poor	0	0	0	0	0	0	0	0	0	0																
	2. good											0	0	0	0	0	0										
	3. excellent																										
Ease of Removal - Relocation:	1. poor	0								0																	
	2. good		0	0	0	0	0	0	0		0																
	3. excellent											0	0	0	0	0	0	0	0								

4-5.1 GENERAL: Partitions are conveniently grouped in five main categories, which relate to their degree of locational permanence. These categories are: fixed, replaceable, demountable, portable, and operable.

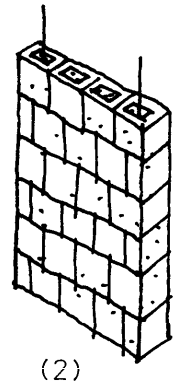
4-5.2 FIXED PARTITIONS: Fixed partitions are intended to remain in place for the life of the building. Though any wall can be demolished, walls that are part of the building Support structure, or are reinforced concrete or masonry walls, are obviously relatively difficult to remove, and should be considered fixed.

4-5.2.1 Characteristics: Fixed partitions are generally constructed of precast or poured-in-place concrete (1), or masonry (2).



(1)

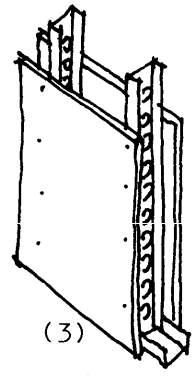
4-5.2.2 Use: Fixed partitions should be carefully located so that they will not limit building flexibility. Desirable locations are at the building perimeter, or associated with other permanent elements, such as toilets, stairs, and elevators. In seismic areas, interior fixed partitions may serve as lateral resisting elements and be located for structural purposes. The location of these partitions is most critical because their later removal is all but impossible.



(2)

4-5.3 REPLACEABLE PARTITIONS: Replaceable partitions are non load-bearing, but are not reusable when removed.

4-5.3.1 Characteristics: Replaceable partitions are constructed of metal lath, studs and plaster, gypsum board and studs, or un-reinforced concrete masonry, sol id gypsum blocks or tiles. (3)



(3)

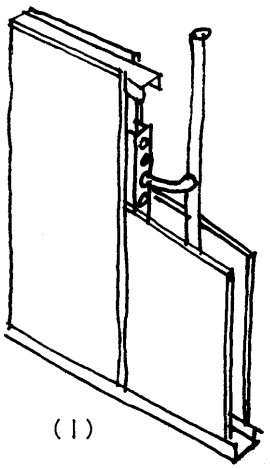
4-5.3.2 Uses: Replaceable partitions are used where eventual relocation is a possibility, but frequent movement is not anticipated.

4-5.4 REMOUNTABLE PARTITIONS: Remountable partitions are defined as relocatable partitions that are an assembly of structural frames, panels and trim which together provide a rigid, finished space-dividing assembly.

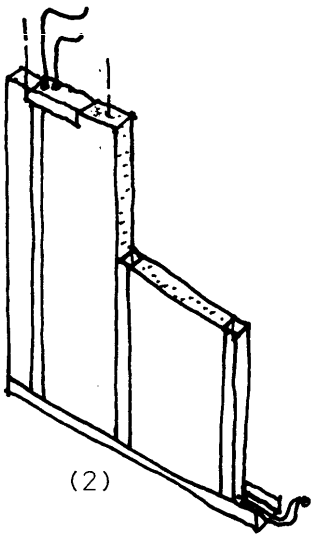
4-5.4.1 Characteristics: The stability of this system usually is achieved through the anchorage of floor and ceiling channel members into which the vertical structural studs clip. Snap-on trim is applied to cover raw edge conditions. There are two general systems:

A. Stud and Facing Panels: Panels on either side of the structural frame are independent and can therefore be removed and replaced on one side of the partition without interrupting the activity of the other. Panel faces may also be of different materials or finishes. The void may be filled with insulation to increase the soun d attenuation rating of the wall or used for the instal lation of concealed electrical or plumbing lines. (1)

B. Post and Panel: A system of posts are attached to a ceiling track and a floor track and the spaces between are filled with a composite panel, glazing or doors. (2)



(1)

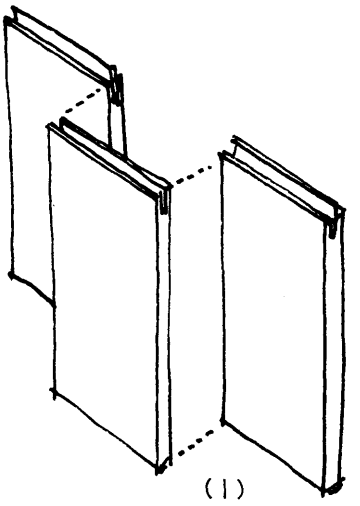


(2)

4-5.4.2 Uses: These systems are appropriate when partitions are expected to be moved fairly infrequently, as part of major space rearrangements. Trained personnel are necessary to move these partitions.

4-5.5 PORTABLE PARTITIONS: Portable partitions are defined as relocatable partitions generally having prefinished surfaces, both sides, and being fabricated as a single repetitive unit that can be simply handled and erected by non-skilled labor. (1)

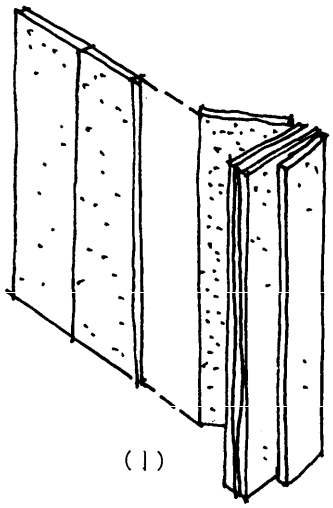
4-5.5.1 Characteristics: This partition is light in weight and is capable of Attachment to floors and ceilings by friction or minimal mechanical means. These two characteristics tend to reduce the effectiveness of such systems as acoustic separators, since weight is a function of density and continuous firm attachment is a requirement for optimizing the reduction of sound transfer through joints in the assembly. Portable partitions, for similar reasons, tend not to be well--suited for resistance of lateral loading, either as impact or sustained loads.


(1)

4-5.5.2 Uses: These systems are appropriate when it is expected that walls will be moved relatively frequently, and where their inability to house electrical and plumbing services is not disadvantageous.

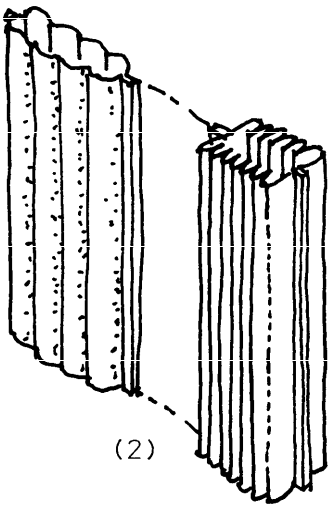
INTERIOR PARTITIONS

4-5.6 OPERABLE PARTITIONS: Operable partitions are defined as those that are readily movable along tracks for the subdivision of a large space into two or more smaller spaces. When not in use, they stack against walls perpendicular to the path of travel, or into a storage pocket designed for that purpose.



(1)

4-5.6.1 Characteristics: Operable partitions vary widely, from heavy rigid panels that interlock when in position to provide a very robust and durable wall (1), to a light fabric covered accordion folding door which serves primarily as a visual barrier (2). Light-weight doors are generally manually operated, while heavy panelized walls are motor operated.



(2)

4-5.6.2 Uses: These partitions are used when immediate and easy space subdivision is necessary.

4-5.6.3 Decorative Limitations: While the space adaptability achievable through the use of readily movable partitions is obvious, their use tends to limit the decorative character of spaces so subdivided, and it is difficult or impossible to change the character or to redecorate their factory applied finishes.

Hence, surface finishes of operable partitions should be of neutral colors, or in natural materials, that will not establish the dominant design character of the space affected. Changes may then be introduced through furnishings, drapes, carpet replacement and redecoration of non-movable wall surfaces and lighting.

4-5.7 FINISHES:

All partitions can receive a variety of finishes. Choice of finish should be determined on the basis of use, potential abuse, appearance, cost and expected degree of performance.

4-5.7.1 Types of Finish:

The general characteristics of a group of commonly applied finishes are noted below:

A. Plastic laminates:

These are available in a variety of solid colors and patterns, with minor textural variations. These provide a very hard wearing surface, ‘resistant to stain, and easily cleaned. If damaged, however, patching is not possible.

B. Vinyl fabric:

Thin sheet plastic surfacing, applied in the factory or in the field. Available in a variety of textures, colors, and patterns. Easily cleaned, and can be patched. Care necessary to ensure use of correct adhesives.

C. Wood veneer:

Generally hardwood: used where the variety and natural texture of wood is desired. Applied by adhesive: normal wood finishes used for protection.

D. Imitation wood veneer:

Similar to A, but using photographically reproduced wood veneers. Popular because wood grain in finish conceals marks and minor blemishes, and is much easier to maintain than natural wood.

E. Paint:

Inexpensive, easily marked and damaged, but easy to replace. Care must be taken to select correct paint type for use, since there are a great variety of paint materials.

INTERIOR PARTITIONS

Table 4-5 Partitions: Cost/Performance Summary

			FIXED		REPLAC-ABLE		DEMOUNT-ABLE				OPER-ABLE		FINISHES				
			concrete	masonry	plaster	block	post & panel	stud & facing	panel	portable	accordion	panel	plastic lamin.	vinyl fabric	wood veneer	imitation wood veneer	paint
COST INDEX (base 100)	1	high	450	135	100	135	200	175	200	300	225	350	175	65	400	100	10
	2	low	310	220	75	220	125	90	100	225	200	300	100	25	40	50	75
PERFORMANCE																	
Fire Rating:	3	none															
	4	incombustible									0*	0*					
	5	to 1-hour								0							
	6	to 2-hour					0	0	0								
	7	+ 2-hours	0	0	0	0											
Acoustics: S.T.C.	8	28-42								0							
	9	up to 46									0	0					
	10	36-52					0	0	0								
	11	wide range	0	0	0	0											
Lateral Load p.s.f.	12	0-5									0	0					
	13	0-7.5								0							
	14	0-15	0	0	0	0	0	0	0								
Wiring Access	15	none	0	0		0				0	0	0					
	16	difficult			0				0								
	17	easy					0	0									
Clearance for piping	18	none	0	0		0			0	0	0	0					
	19	limited			0		0	0									
	20	good															
Relocation rate, ft/man hour	21	demolition	0	0	0	0											
	22	1-4					0	0	0								
	23	30-80								0							
	24	very fast									0	0					

* Operable partitions may be incombustible: not used for fire separations

4-6 CEILING

4-6.1 FUNCTIONS: The primary functions of the ceiling as a design element are that it provides visual protection from view of the underside of a structure; controls the acoustic properties of the space containing the ceiling; and may provide a standard of fire resistive protection to that part of the building and its structure directly above.

An additional function, that of providing an aesthetically pleasing surface, tends to be regarded as the least important since no definitive standards of performance exist, unlike those for fire-resistive construction or acoustics.

The ceiling surface often provides a plane which many secondary building subsystems penetrate. These include mechanical air distribution diffusers and grilles, fire sprinkler systems, electrical alarm systems, lighting fixtures, public address speakers, emergency exit signs and occasionally penetrations by pipes and ducts exposed to view from remodeling, presumably through expedience.

4-6.2 APPEARANCE: Common deficiencies in ceiling appearance include pattern staining of dirt accumulating around return air registers, accentuated by the introduction of replacement tiles, often of another design than the original ceiling.

The key to good appearance in ceiling design lies in the reduction of the number of elements permitted to occur in the ceiling plane and the integration of those that are exposed into a pattern using similar forms, e.g., square fixtures, air registers, speaker boxes, etc. Many manufacturers produce ceiling assemblies in which the lighting fixtures, acoustic tile panels and air diffusers are integrated with a consequent gain in appearance.

4-6.3 FIRE RESISTIVE STANDARDS: The most stringent performance requirement of a ceiling system is the need to conform to standards of fire-resistive construction.

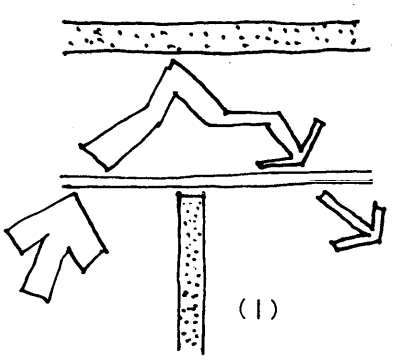
The National Fire Protection Association defines assemblies of materials of construction and tests and rates them for fire resistance.

Fire resistive standards are generally expressed for a complete structure/ ceiling assembly, and approvals refer to assemblies that are identical in every detail with those tested. Hence, ceiling systems are seldom given a fire resistance rating independent of accompanying structure elements.

4-6.4 REFLECTIVITY: Where ceilings are to be used to reflect indirect lighting, the reflective values of the ceilings should exceed 80%. Where this is not required, there is considerable scope for enriching ceiling surfaces through the introduction of color and materials.

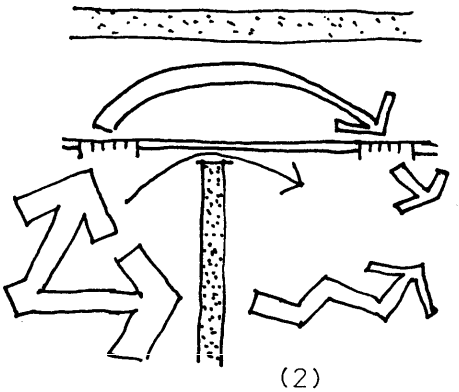
4-6.5 SOUND ATTENUATION: A suspended ceiling acts as a plane of sound separation between spaces. When partitions do not penetrate the ceiling, the ceiling plane becomes the critical sound attenuation element.

Note that the attenuation capability of the ceiling plane need only be approximately one-half that of the partitions, since sound must travel through two ceiling planes. (1)



(1)

Other critical aspects of ceiling sound attenuation include the presence of openings in the ceiling (return air registers for example) and the effectiveness of partition head attachment in ensuring that sound cannot leak over the top of the partition. (2)



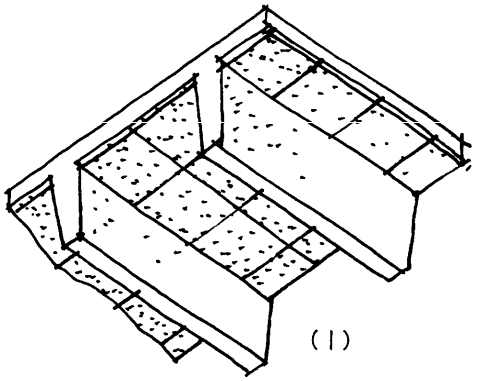
(2)

4-6.6 SOUND ABSORPTION: The ceiling provides a large area for the absorption of sound. Quiet spaces and dining areas should use highly absorbent ceiling materials. Large multi-use rooms should be analyzed by an acoustical engineer to provide criteria for absorption standards and material recommendations.

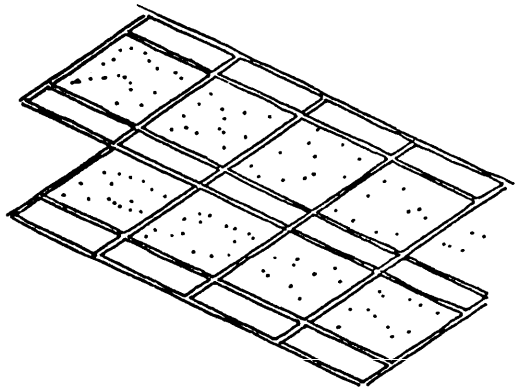
4-6.7 INTEGRATED CEILING SYSTEMS: Pre-engineered ceiling systems are available in which ceiling materials are integrated with lighting fixtures, air diffusers, and sometimes sprinkler heads. Most assemblies offer a selection of ceiling/lighting types including three dimensional coffers, luminous ceiling, and flat panels to receive surface mounted or recessed fixtures.

4-6.8 CEILING TYPES: There are three generic types of ceiling to be considered. These are:

A. Direct Application to Structure: (1) The direct application of coatings or sheet materials to the building horizontal structure. Materials used are:
- paint, stain: applied to concrete, metal deck or wood deck
- Gypsum board: applied to wood joists
- acoustic tile: glued or mechanically fastened to wood joints, concrete, or metal deck


(1)

B. Grid and Panel Type (2), A suspended grid assembly supporting infill panels, light fixture, and HVAC components. Materials used are:
- ceiling grid assembly: aluminum or steel
- in-fill panels: metal pans, tiles made of glass fiber, wood fiber, mineral fiber, or ceramic
- finish: natural, painted, plastic-coated


(2)

C. Suspended Plaster Ceiling: (3) The use of plaster materials hung on furring members below the horizontal structure. Materials used are:
- channels: steel, untreated or galvanized
- plaster: gypsum plaster, cement plaster, acoustical plaster

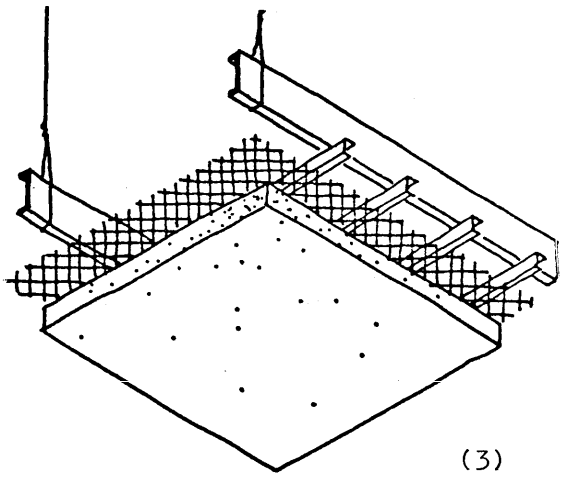

(3)

Table 4-6 Ceilings: Cost/Performance Summary

		DIRECT APPLICATION			GRID & PANEL SUSPENDED						SUSPENDED PLASTER		
		paint	gyp.board	acous.tile	min.fiber tile	fiberglass	wood fiber tile	gyp.board	perf.alum.pan	st. stl. pan	cement	gypsum	acoustical
COST INDEX (base 100)	1. high	15	100	100	180	180	115	110	210	500	210	115	165
	2. low	10	50	50	125	110	100	100	200	415	190	100	100
PERFORMANCE													
Fire rating	3. none - + 2 hours		0		0	0	0	0	0	0	0	0	0
	4. dependent on structure	0		0									
Accessibility	5. none												
	6. limited		0								0	0	0
	7. good	0		0	0	0	0	0	0	0			
Compatibility HVAC	8. limited		0								0	0	0
	9. good	0		0	0	0	0	0	0	0			
Lighting	10. limited										0	0	0
	11. good	0	0	0	0	0	0	0	0	0			
Dimensional Flexibility	12. limited				0	0	0		0	0			
	13. good	0	0	0				0			0	0	0
Durability	14. fair	0	0	0	0		0	0				0	0
	15. good					0			0		0		
	16. excellent									0			

* Note: Acoustic capability of all systems are comparable, depending on materials and design.

4-7 LIGHTING

4-7.1 GENERAL: Consideration of lighting requirements for club facilities should include both natural and artificial sources, both from a quantitative and a qualitative viewpoint.

Programming and design decisions should be made by rational process whereby the most beneficial performance can be obtained at an acceptable cost . Any cost/benefit analysis should take into consideration the service life of design alternatives under consideration, their energy consumption, and their effect on heating and cooling energy usage.

4-7.2 NATURAL LIGHTING: Natural lighting should be considered to be most desirable for those activity areas such as lounges and dining rooms, where the occupants can enjoy varied natural light and outside views. For other activities, such as administrative offices and staff work spaces, planning for natural lighting and view by articulation of the exterior wall or by the introduction of overhead skylights, can be beneficial. Glare from direct sunlight should be carefully controlled by the provision of awnings, louvers or blinds for times of excessive exposure.

4-7.3 LIGHTING DESIGN AND EVALUATION: Assessment of the worth of natural lighting is largely subjective. Practical considerations include the degree to which artificial light can be saved by the introduction of perimeter switching zones that would facilitate the saving of power during daylight hours. A staccato-like rhythm of' alternating narrow vertical windows and solid walls can often detract from the quality of light and, by causing uncomfortable glare, conflict with the implied intent to provide a view.

4-7.4 NEED FOR UNIFORM CRITERIA: It is recognized that many of the tasks performed in a club do not require great visual acuity. This particularly applies to areas such as the bar and dining room. Lighting criteria in these areas should be pursued more to obtain an attractive and appropriate atmosphere, rather than attempting to maintain uniform high lighting standards.

4-7.5 PRINCIPLES: General principles of good lighting will dictate that adequate illumination is provided at the working plane to perform a given task, that contrasts between the intensity of light at the source and its immediate surrounding is controlled, and that glare and reflections are minimized.

4-7.6 LIGHTING STANDARDS: Design requirements for lighting should comply with the recommendations of the IES Lighting Handbook. (See DOD 4270.1-M, Section 7, page 1.)

The levels of illumination recommended for the generic space types are shown in Table 4-7.

Table 4-7 Lighting Standards for Generic Spaces

Generic Space	Ft. Candles on Task
1. - Entry, incl. secondary entries:	
(entrance foyer)	30
coat room (locker rooms)	20
telephone room (telephone equip. room)	20
2 - Dining (dining areas)	
cashier station	50
(intimate type, light environment)	10
(intimate type, subdued environment)	3
(for cleaning)	20
(leisure type, light environment)	30
(leisure type subdued environment)	15
(quick service type, bright surroundings)	100
(quick service type, normal surroundings)	50
(food displays, twice normal but not less than:)	50
maitre'd station	NA
waitress station	NA
serving center	NA
3 - Bar all sub-spaces	NA
4 - Kitchen	
all sub-spaces (kitchen, commercial)	70
5 - Ballroom/Multi-Use	
(dance halls)	5
(auditoriums, assembly)	15
(auditoriums, exhibition)	30
(auditoriums, social activities)	5
dressing rooms (locker rooms)	20
6 - Party all types - See Dining, Ballroom & Recreation	
7 - Recreation, quiet	
reading (lounge and reading rooms)	30
lounge (lounge and reading rooms)	30
T.V. room	NA
8 - Recreation, noisy	
games (table games)	30
pool table	50

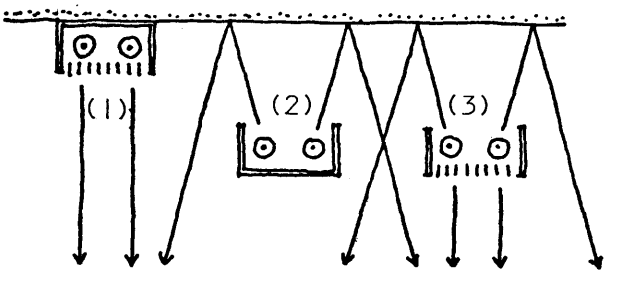
Generic Space	Ft. Candles on Task
9 - Administration	
office, general (reading poor reproduction)	70
office, cashiers (accounting office)	70
reproduction room (business machine operation)	70
10 - Restroom	
toilets (toilets and washrooms)	30
powder room (grooming, shaving, make-up)	50
11 - Storage	
(inactive)	5
(active, medium bulky)	20
12 - Mechanical	
all sub-spaces (utility room, general)	20
13 - Circulation	
hallways (entrance foyer)	30
corridors	20
stairs	20
elevators	20
14 - Locker Rooms	
all types	20

NA = Not available. Task assumed not to be critical for acute viewing.
( ) = Area reference in IES Lighting Handbook

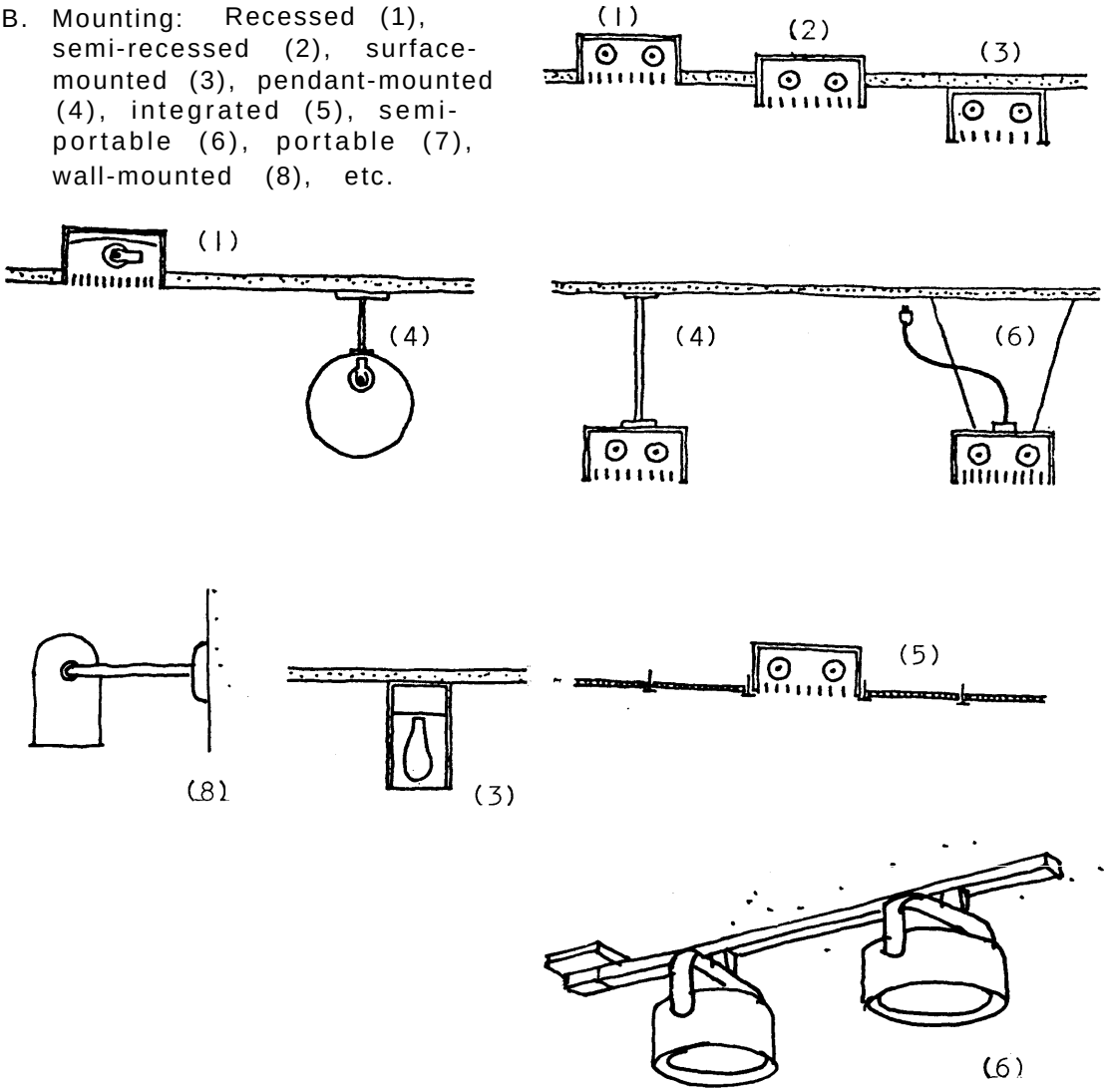
4-7.7 LIGHTING METHODS SUMMARY: Current standard methods of providing artificial lighting are shown in diagrammatic form. The lighting sub-system is conveniently grouped into the component categories of fixtures, lamps, shielding devices, controls, and special components. The methods shown are not necessarily recommended, and must be evaluated for specific intended uses.

4-7.7.1 Fixtures

A. Direct (1), indirect (2) and semi-direct (3)



B. Mounting: Recessed (1), semi-recessed (2), surface-mounted (3), pendant-mounted (4), integrated (5), semi-portable (6), portable (7), wall-mounted (8), etc.

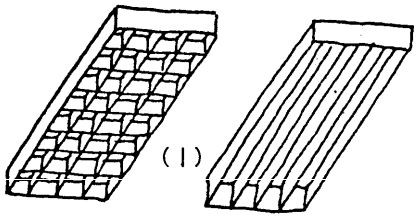


4-7.7.2 Lamps

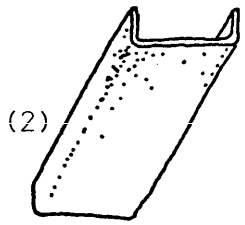
	output	Color Rendition	Energy Use
Incandescent	25-500 W	Good	Poor
Fluorescent	430-1500 MA	Std. white, cool white & warm white.	Standard
Mercury Vapor	100-250 W	Deluxe white, clear, color improved.	Good
Tungsten-halogen	500 W	Poor	Effective

4-7.7.3 Shielding Devices

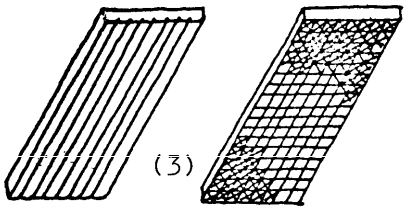
A. Louvers: A device that improves the cut-off angle characteristics and reduces glare. Materials are plastic or metal , used in a one-way or two-way configuration. (1)



B. Diffusers: A device that lowers the surface brightness of the light source by spreading it over a greater area. Materials are frosted translucent glass or plastic. (2)



C. Lenses: A device that imprints some photometric pattern to the light. Materials are glass or plastic, and typical configurations are prismatic, ribbed, striated and polarized. (3)



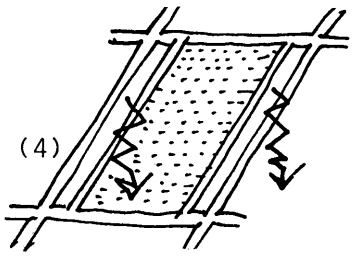
4-7.7.4 Controls

A. Circuiting: Direct, or low voltage.

B. Devices: One-way switch, three-way switch, zone switching, automatic switching, dimming.

4-7.7.5 Special Components

A. Air Diffuser: Light troffer units can be provided with integral air diffusers apertures. (4)



B. Non-corrosive Construction: Can be provided when required, e.g., kitchen.

C. Special Lighting Requirements: Color effect, food display service in dining room.

4-7.7.6 Cost: The cost of decorative lighting can vary enormously, depending on the type of individual lighting fixtures used. The cost of fluorescent area lighting, for use in functional areas, varies predominantly with the desired intensity of illumination. The range of variation is indicated in Table 4-8.

Table 4-8 Lighting: Cost/Performance Summary

Lighting Level foot candles (lamps/100 s.f.)	Watts/s.f.	Initial Cost/s.f. High	Low	Operations* Cost/s.f./yr.
30 (2 lamps)	0.80-1.25	100	86	100
50 (4 lamps)	1.60-2.50	180	154	200
100 (8 lamps)	3.20-5.00	350	290	400
200 (16 lamps)	6.40-10.00	600	510	800

*Includes lamp replacement and energy usage.