

**DIVISION N  
CLASSROOM AND LECTURE HALL DESIGN  
INDEX**

N.1	INTRODUCTION TO THE GENERAL PURPOSE CLASSROOM (GPC).....	2
N.2	SITE AND SPACE RELATIONSHIPS (GPC).....	2
N.3	DIMENSIONS (GPC).....	4
N.4	WINDOWS (GPC).....	4
N.5	FINISHES (GPC).....	5
N.6	ACOUSTICS (GPC).....	6
N.7	LIGHTING AND LIGHTING CONTROLS (GPC).....	7
N.8	ELECTRICAL AND COMMUNICATION SERVICES (GPC).....	8
N.9	FURNISHINGS AND EQUIPMENT (GPC).....	9
N.10	OTHER SPECIAL CONSIDERATIONS (GPC).....	11
N.11	INTRODUCTION TO LECTURE HALLS (LH).....	12
N.12	SITE AND SPACE RELATIONSHIPS (LH).....	12
N.13	DIMENSIONS (LH).....	13
N.14	ENTRANCES AND EXITS (LH).....	14
N.15	WINDOWS (LH).....	14
N.16	FINISHES (LH).....	15
N.17	ACOUSTICS (LH).....	15
N.18	LIGHTING AND LIGHTING CONTROLS (LH).....	16
N.19	ELECTRICAL AND COMMUNICATION SERVICES (LH).....	17
N.20	MEDIA CLOSET (LH).....	18
N.21	FURNISHINGS AND EQUIPMENT (LH).....	18
N.22	OTHER SPECIAL CONSIDERATIONS (LH).....	21

**DIVISION N  
CLASSROOM AND LECTURE HALL DESIGN**

**N.1 INTRODUCTION TO THE GENERAL PURPOSE CLASSROOM**

- A. The basic premise is that, regardless of the method of instruction being used, a classroom learning environment will allow students to see anything presented visually, to hear any audible presentation free from noises and distortions, and to be physically comfortable (air flow, temperature, furniture, etc.).
- B. Three (3) categories of classrooms are described in this document. A general-purpose classroom is defined as a room designed to house 75 or fewer students, with at least 350 square feet and a minimum capacity of 20 student stations. Anything less than that, in terms of size or capacity, is defined as a seminar room. Classrooms designed for more than 75 students are considered lecture halls. Separate sections of guidelines have been prepared for each type of classroom; however, the lines between them are not absolute and require some interpretation based on individual facilities and applications.
- C. These guidelines are not intended to establish standards for all classroom construction and renovation, but rather to serve as a guideline. The number of variables that must be considered in classroom design is almost infinite. They must be adapted to fit the local needs, mission, and individual preferences of each institution as well as conform to applicable state and local codes.

**N.2 SITE AND SPACE RELATIONSHIPS FOR THE GENERAL PURPOSE CLASSROOM**

- A. Classrooms should be concentrated on the lower floors of buildings. This provides better student access and allows instructional support services to be provided more conveniently. A building with mixed functions (classrooms, offices, and/or laboratories) should have a classroom core that is separated from the other functions.

Classrooms should be located away from noise-generating activities taking place either outside or inside the building. To reduce external noise, it is important to consider sound separation from such areas as streets, parking lots, housing areas, plazas or other areas where students gather, recreation sites, athletic fields, trash pickup sites, and loading docks. To reduce internal noise, classrooms should not be located adjacent to building mechanical systems, elevators, restrooms, vending areas, etc.

- B. Entrances/exits:
  - 1. To reduce the impact of exterior noise and temperature differences, building entrances into general-purpose classroom areas should have two (2) sets of doors, one from the outside into a vestibule and a second from the vestibule into the building.
  - 2. The principal determinant of the location of these entrances should be the flow of student traffic. Entrances should be close to classrooms so that students do not have to travel great distances through non-instructional areas to reach classrooms. It also should be recognized that a large number of students passing through hallways to exits represents a potential source of disturbance to classes in session.
  - 3. In determining the size of entrances/exits, local building codes should not be the

sole criterion. It is important to plan for a flow of students between classes which can be double the capacity of the rooms serviced by an entrance/exit. It is unrealistic to assume that all of the students leaving will be gone before the students coming to the next class begin to arrive.

C. Entrances and exits in rooms:

1. Rooms having a capacity of fewer than 50 normally should have entrances/exits at the rear of the room. Rooms of 50-75 capacity should have two (2) entrances/exits preferably at the rear of the room.
2. Entrances and exits are to facilitate the easy passage of people with disabilities. The entrances should accommodate moving equipment in and out of the room.
3. Doors should be a minimum of three (3) feet wide and should have a vision panel in order to prevent injury when being opened. Vision panels are to be tempered glass and should be tinted to reduce light transmission. The glass area should not exceed 100 square inches. The base of the vision panel should be no more than 40 inches above the floor, and the top of the vision panel should extend at least 64 inches above the floor. Classroom doors should have a lever and/or panic bars with closers for people with disabilities.
4. Doors should be equipped with rubber bumper door silencers.
5. Doors should be located so as to minimize congestion problems in the hallway when classes are changing. When possible, doors should be recessed into the room so that the door does not swing into the hallway.
6. Kick plates shall be installed on the egress side of all doors.
7. Locks installed in the doors should be "classroom function" hardware, key or combination key pad operation. A key pad type should also have the lock and unlock "classroom function".

D. Hallways:

The design of building housing classrooms should recognize that students will be in the hallways or public areas while classes are in session. Thus, some built-in or permanently affixed seating should be provided. Lacking seating, students will sit on the floor, which has the potential of interrupting the traffic flow through the hallways.

E. Vending Areas:

Vending areas should be as remote as possible from the classrooms. They should be located in an alcove or other similar locations so as to minimize the congestion factor resulting when students are using the machines.

F. Trash and Recycling Containers:

Trash and recycling containers should be located both in the vending area and in the classroom area.

G. Directory of Classrooms:

A directory of the location of classrooms should be provided at each entrance along with a directory of any other relevant function that may exist in the building. If there are multiple corridors leading away from a point of entry to a floor, directional signs should indicate the location of classrooms.

### N.3 DIMENSIONS OF THE GENERAL PURPOSE CLASSROOM

- A. Classrooms should be designed so that the length is approximately one and one-half times the width of the room. Rooms wider than they are deep normally present unacceptable viewing angles for projected materials and for information written on the chalkboard. With the increased use of projected materials, especially computer imaging, the shape and dimensions of classrooms are more critical than ever before.
- B. The instructor area should be on the narrow wall of the room.
- C. There should be no obstructions (such as posts) anywhere in the classroom. The front wall of the room behind the instructor area should have no protrusions into the room so that a chalkboard/markerboard can be installed across the entire wall of the instructor area.
- D. Ceiling heights will vary depending upon the size of the room. The following are suggested minimum ceiling heights:

<u>Capacity</u>	<u>Flat Floor</u>	<u>Sloped Floor</u>
up to 20	10 feet	
21-49	10 feet	
50-79	12 feet	8 feet in rear, 12 feet in front

- E. In general, sloped floors are appropriate only in larger general purpose classrooms. The incline of sloped floors should be no more than a 1:12 ratio. In addition, there should be an entrance at the lower end of the sloped floor so that equipment can be brought to the teaching station of the room and wheelchair access can be provided.

### N.4 WINDOWS FOR THE GENERAL PURPOSE CLASSROOM

- A. Considerations for rooms with windows:

Window treatments should be opaque and should be capable of eliminating outside light from reaching the projection screen(s).

1. **Venetian Blinds:** If Venetian blinds are used, the slats should have a non-reflective matte finish. Maximum light control is achieved when Venetian blinds are installed with channels to provide a light-tight abutment to the window frame. It should be noted, however, that Venetian blinds, even those with channels, will not provide sufficient room darkening when electronic projection is being used.
2. **Roller Blinds:** Opaque roller blinds offer significantly more light control than Venetian blinds, particularly if the roller blinds are installed with channels to prevent light leakage around the edges.

- B. When windows are installed, particularly on the south side of the building, it is recommended that tinted glass with a low E rating be used. This will reduce the heat transfer from the outside to the inside of the room. Double or even triple, glazed windows will assist in reducing heat transfer as well as provide a barrier to exterior noise entering the room.
- C. Even when windows are preferred in classrooms, the surface should be kept at a minimum. Window surfaces should be at the side of the room and not located in the front rear of the room.

## **N.5 FINISHES FOR THE GENERAL PURPOSE CLASSROOM**

### **A. Color and Reflectance Values:**

1. Selection of color and reflectance values of finish materials must be considered for all classrooms. In general, white surfaces should be specified only in unusual situations. Painted surfaces should be light in color.
2. Special care must be given to rooms where televised instructional activities will originate. Light blue and beige are good choices for these areas. In addition, finishes should be non-glare.
3. Reflectance value of paints, vinyl coverings, laminates, and other finish materials should be selected to enhance ambient illumination and the illumination at working surfaces. The following values are recommended:

Ceilings	70-90%
Walls	40-60%
Floors	30-50%
Desktops	35-50%
Chalkboards	20-30%

### **B. Floors:**

1. The floor in the general classroom should be vinyl or rubber tile with a smooth surface. Carpeting, if used, needs to be factored into the overall acoustical characteristics of the room.
2. The floor covering should be a medium to light color and should contain some kind of subdued pattern of fleck to break the monotony and to improve the overall maintenance of the floors.
3. A four-inch base should be installed around the walls.

### **C. Walls:**

1. A chair rail should be installed whenever movable seating is used in the room.
2. The finishes used in a classroom should be chosen with the room's acoustical characteristics in mind.

### **D. Ceilings:**

Ceilings should be of a light color and non-reflective material.

## N.6 ACOUSTICS FOR THE GENERAL PURPOSE CLASSROOM

### A. Walls:

1. Walls in general-purpose classrooms should have a Sound Transmission Coefficient (STC) rating no less than 50.
2. Walls must extend to the floor above or to the roof construction, and not stop at the ceiling. This will reduce noise transmission as well as improve security.
3. Higher STC ratings and special wall-construction details must be included whenever classrooms are located adjacent to, above, or below restrooms, mechanical rooms, elevator shafts, athletic facilities, or other sources of high noise levels or where the classroom function generates a significant amount of noise.
4. Concrete masonry units may be used, but may have to be covered with another finish in order to provide proper acoustical treatment.
5. Folding walls are extremely undesirable and should not be used except under very extraordinary circumstances. It is difficult to develop a folding-wall design that is able to maintain adequate sound separation between classrooms.
6. Sound levels as generated by mechanical systems or other ambient noise measured at all points in a classroom at four feet above the floor must have an Noise Criterion (NC) rating of no more than 35.

### B. Ceiling:

1. The surface of the ceiling must be designed to accommodate the required acoustical properties of the room. The area of the ceiling to be acoustical tile is a function of ceiling height.

<u>Ceiling Height</u>	<u>% of Acoustical Title</u>
10 feet	40-50
10 feet	50-60
12 feet	50-60

2. These numbers presume the use of Noise Reduction Coefficient (NRC) .55 -.65 tile in a ceiling suspension system. The acoustical tile should be arranged in the form of a U around the perimeter of the room, with the opening at the front and the rest of the ceiling a hard material such as gypsum board or plaster.

### C. Mechanical Systems:

1. The mechanical system supporting general-purpose classrooms should generate a background noise of no more than NC 35. To achieve this, the system requires not only careful design, but competent installation, balancing, and a regular maintenance program once installed.

2. Factors that influence the design of a quiet operating system include air handlers or fans located away from the classrooms; low velocity or air within the room; and proper sizing and acoustical treatment of ducts, returns, and diffusers.
3. The air changes and circulation of air per ASHRA standards is a critical factor in instructional spaces. This must be achieved with effective control of HVAC system-generated background noise.

D. Utility Boxes:

When classrooms share a common wall, electrical receptacles or other utility boxes should not be installed back-to-back with similar receptacles in the next room. Off-setting the boxes will reduce sound transmission between rooms.

E. Window and Floor Treatments:

Window and floor treatments should be selected as an integral part of the acoustical treatment of the room.

## **N.7 LIGHTING AND LIGHTING CONTROLS FOR THE GENERAL PURPOSE CLASSROOM**

A. The control of light in a general-purpose classroom has become increasingly important with the growing use of technology in teaching. While the correct lighting levels can be achieved through a variety of approaches, it is essential that classrooms have the full range of lighting possibilities, from a comfortable reading level to darkening sufficiently to allow for all types of projection of information while still permitting note taking.

B. Controls:

1. Switching should be kept simple, with the use in mind. Light switches should be clearly labeled as to function. Standardization among rooms is recommended.
2. Switching for the room lights should be provided at every entrance to the room. In addition, the room lights should be controlled from the teaching station as should lights that are capable of being dimmed.
3. To accommodate projection needs, room lights should be switched by zone from the front to the rear of the room, thus making it possible to reduce the lighting in the front of the room and maintain the normal lighting level toward the rear of the room.
4. Automated light control systems should provide for a manual override.

C. Ceiling Lighting:

1. The room lights should provide 50-60 foot-candles at each writing surface, including the teaching station. There should be an even level throughout the room with no bright spots or dark spots. Diffusers used in ceiling fixtures should be non-reflective.
2. It should be possible to reduce the lighting in the room to 5-10 foot-candles over the seating area with all direct light eliminated from the instructor and projection

screen areas. Provisions need to be made for a highly concentrated light source which allows the instructor to see notes.

3. Fluorescent lights should be three (3) lamps with two (2) lamps switched together and the center map switched separately. Dimmable fluorescent lights should not be used.

D. Chalkboard/Markerboard Lighting:

1. Illumination of the chalkboard/markerboard should be at a level of 75 foot-candles uniformly across the entire writing surface. Chalkboard/markerboard lighting may be necessary in rooms of more than a 50-student capacity. The lighting should be installed so it does not create bright spots or shadows on the surface of the board. Further, the lamps in the fixtures should not be directly visible to students sitting in the front rows of seating.
2. Chalkboard/markerboard lights should be switched in two (2) sections so that one (1) part of the board can be illuminated when one projection screen is being used.
3. Lights also should be mounted so as not to interfere with the effective use of the projection screens.

E. Other Considerations:

Emergency lighting and exit signs should conform to local codes and should be located so as not to produce ambient light on the projection screen or otherwise compete for visual attention. Emergency lighting should be controlled by a 60-minute timer switch.

**N.8 ELECTRICAL AND COMMUNICATION SERVICES FOR THE GENERAL PURPOSE CLASSROOM**

A. Electrical Services:

1. Electrical services should be protected from surges and spikes. Except in the case of very special needs, outlets should not be controlled by any switch that could be confused for a light switch.
2. Each room should have one (1) or more dedicated circuits on a breaker, not shared by any other room.
3. New construction or major renovations should make provision for a minimum of 20 percent, with a recommended 40 percent, future increase in the need for electrical services in the classroom area. This would include additional capacity in the breaker box for this future use.
4. The number of electrical outlets in the room will depend in part on special functions that many are assigned to the room. In general, rooms under 50 capacity should have a single duplex outlet in each side of the room, one (1) fourplex outlet in the rear wall of the room centrally located, two (2) duplex outlets in the front corners of the room, and one (1) fourplex outlet located in the center of the front wall.



5. In rooms of 50-75 capacity, there should be two (2) outlets evenly spaced in each side wall, three (3) fourplex outlets in the front wall, and two (2) fourplex outlets in the rear.
6. Outlets should be mounted 24 inches above the floor.

B. Telecommunications:

1. There should be one (1) dedicated telecommunications closet of adequate size per wing, per floor of a classroom facility. Attention should be given to the HVAC needs of these telecommunications closets because of heat generated by the equipment.
2. The conduits or cable tray from the telecommunications closet to each classroom should make provisions for voice, data, and video. The cable tray shall have divisions for each type of cable.
3. Telecommunications wiring shall be separated from the electrical circuit(s). The low-voltage services should be isolated from each other through separate conduit. These services include controls for slide projectors, audio, video data, and voice feeds. These circuits should not be tied to the ground.
4. Circuits should be clearly labeled at termination locations.
5. Classrooms will contain a secure media closet or cabinet to contain the electronic equipment and rack. The closet will be approximately 42" x 42" inside, lined with  $\frac{3}{4}$ " plywood or expanded metal and drywall with a lockable  $\frac{3}{4}$ " plywood door and  $1\frac{3}{4}$ " solid core wood outer door with mortise hardware.

## **N.9 FURNISHINGS AND EQUIPMENT FOR THE GENERAL PURPOSE CLASSROOM**

A. Instructor Area:

A sturdy 30" x 60" table or desk, or custom console should be placed at the front of the room as part of the instructor area. This area should also include either a tabletop or free-standing floor podium with a minimum surface of 24" d. x 30" w. There should also be a stool or chair available at the teaching station. This furniture should be coordinated with the other furniture in the room.

B. Student Stations: (See typical classroom layout plans for various seating types)

1. Movable Seating:

It is recommended that rooms under 50 capacity should have movable seating unless there are special considerations.

The tablet arms should contain at least 150 square inches of writing surface. While larger tablet arms are desirable, such factors as durability and stability also must be considered. Both the tablet arm and the chair should be durable and comfortable to use.

2. Tables and Chairs:

Tables and chairs are highly desirable because of the additional workspace provided to students. However, this arrangement does reduce the student seating capacity of the room. Tables used in classrooms should be 24-30 inches deep.

3. Fixed Seating:

Rooms of 50-75 capacity should be evaluated as to the intended use in determining whether fixed or movable seating should be installed. However, if a floor is sloped, fixed seating should be used.

4. Left-Handed Seating:

Both movable and fixed seating should contain a minimum of 10 percent left-handed tablet arms or should contain chairs designed to be used by either right- or left-handed people.

5. Wheelchair Stations:

Stations for students in wheelchairs should be provided at approximately four percent of the capacity of the room. These stations should be available in the rear of the room and in the front of the room, assuming appropriate accessibility. To accommodate students in wheelchairs, a table 30 inches deep, 31 inches high, with a 29 inch clearance and 3 feet long should be provided.

C. Chalkboards/Markerboards:

1. General-purpose classrooms should have chalkboards/markerboards across as much of the front wall as possible, and should take into account viewing angles.
2. Chalkboards/markerboards should be mounted with the bottom edge of the chalk tray 36 inches above the finished floor. The boards should be four feet in height and have chalk trays under the full width of the board. Seams on the chalkboards/markerboards should be flush. The surface should provide maximum contrast with the chalk or marker being used.
3. There should be a tack strip above the board and map hooks attached to the top of the board.

D. Voice Reinforcement:

Voice reinforcement should be considered in rooms of 50-75 capacity. The decision should be based on outside noise factors, the acoustical characteristics of the room, and any special needs.

E. Projection Screens and Video Projection:

1. The need for multiple projection surfaces within classrooms is increasing as more technology is being used in instruction. The standard of a single screen mounted in the center of the front of the room, is no longer adequate.
2. Screens should be mounted side-by-side so as not to hinder access to light switches or other controls and maintain the optimum 45° viewing angle to seats.

A minimum of six running feet, preferably eight feet, of chalkboard should remain exposed when either one of the projection screens is in use.

3. Screens mounted parallel to the front of the room should be mounted with the top of the screen 10-12 inches out from the wall. This will allow the screen to clear any chalkboard/markerboard lights and the board.
4. The minimum size for a projection screen should be six (6) feet in width with a larger size if the room is more than 35 feet from front to back. The length of the screen should extend from the mounting location at or very near the ceiling to approximately three feet above the floor, or approximately the level of the chalk tray. The University Center for Instructional Development and Distance Education (CIDDE) has standard screen sizes and equipment specifications for various size classrooms.
5. The first row of seats should be no closer to the screen than one and one-half times the image width on the screen. The optimum is two (2) times the image width to the first row of seats.
6. The standard for the size of projection screens has changed with the introduction of electronic projection. Optical projection (films and slides) have very high-resolution images resulting in a formula of distance from the screen to the farthest viewer of six times the screen width (1:6). The image that fills the screen is clearly visible to everyone with normal vision in any seat in the room using this formula.
7. With the introduction of electronic projection, a new standard must be applied. The standard for these projection systems provides anywhere from 12.5-25 percent of the resolution of optical projection. This is particularly critical in computer image projection, which is often comprised of text. This lower resolution results in a loss of sharpness in edge definition. At marginal viewer distance, the letters tend to blur and fill in, resulting in reduced readability. Screens are to have tap tension.
8. Since the use of electronic projection is increasing rapidly, it is recommended that, the distance from the screen to be the farthest viewer should be revised to four times the screen width (1:4).
9. In a room where the farthest viewer is 40 feet from the screen, a screen 10-feet wide is required.
10. The top of the screen should subtend at an angle no greater than 35° from the horizontal from any seating position. However, some compromises may have to be made in the first few rows of seats to allow sufficient space for chalkboard/markerboard and a reasonable screen size, and yet not have the front seats too far from the front of the room.

## **N.10 OTHER SPECIAL CONSIDERATIONS FOR THE GENERAL PURPOSE CLASSROOM**

### **A. Signage:**

1. Signage in and around a classroom should be kept to a minimum and should be coordinated with other signs and with the general décor of the area.

2. When movable seating is used, a notice as to the capacity of the room should be prominently posted within the room. This will assist in maintaining the proper inventory of student seating in the room.

B. Environmental Issues:

1. The heating, ventilating, and air-conditioning (HVAC) system must provide adequate air changes per hour in conformance with current standards of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE).
2. The temperature range should be maintained within 68-75°, with humidity at 50 percent,  $\pm 10$  percent.
3. Acoustical considerations in determining volume of air-handling noise should include, in addition to the background noise level, any vibration considerations that would generate additional noise.

C. Tack Board:

There should be nothing larger than a tack strip above the chalkboard/markerboard or elsewhere inside the classroom. A tack board in the hall, convenient to each cluster of classrooms, should be used to post student announcements and other types of general information. In addition, a tack board or tack strip should be installed outside of each classroom in the immediate vicinity of the doorway so that grades and other class related items may be posted.

## **N.11 INTRODUCTION TO LECTURE HALLS**

- A. This document focuses on design and size characteristics of a lecture hall defined as a classroom with seating for 75 or more persons.
- B. The three (3) fundamental requirements, to see visual material, to hear without noise or distortion, and to be physically comfortable, are of special concern in lecture halls. Larger lecture halls require more entrances and exits, larger projection screen images, greater voice amplification, more complex lighting and audiovisual control, special acoustical design, and greater control of the environment by the instructor. Problems which occur during a large lecture class are magnified to a greater degree as a result of decreased flexibility in the arrangement of the learning environment and the teaching strategies that can be used.

## **N.12 SITE AND SPACE RELATIONSHIPS FOR THE LECTURE HALL**

- A. Lecture halls should be located to facilitate the movement of large numbers of students to and from the lecture halls. Further, lecture halls should be located so that students can enter or exit the building without passing through major portions of the building that contain other classrooms or spaces for other functions.
- B. Entrances/Exits:
  1. The principal determinant of the location of these entrances should be the flow of student traffic to and from the building. Entrances/exits should be located as

conveniently as possible to these patterns of traffic.

2. In determining the size of the entrances/exits, building codes should not be the sole criterion. First, it is essential to recognize that large numbers of students will be passing through the entrance/exit areas in a concentrated period of time between classes. These considerations should include not only the number of students entering/exiting the lecture hall (roughly double the capacity of the room) but also the number of students who might be going to other locations within the building through the same entrance/exit. Second, this planning must recognize the two-way nature of the traffic flow. Students will enter and exit the building at the same time which can cause congestion unless entrances/exits are designed appropriately.

C. Lobby Area:

1. Lobby space is needed in conjunction with each entrance/exit of the lecture hall. This lobby space should be large enough to allow students to congregate without interfering with the normal traffic flow of students entering or leaving the facility.
2. Seating in the lobby area is needed, but it should be far enough from the entrance/exit to the lecture hall so as to avoid any noise interference caused by normal student interaction. Seating also should be designed with durability in mind and, whenever possible, should be integrated into the overall structure of the building, rather than being placed separately from the building.
3. The surface and finishes in the lobby area should consist of very durable materials because of the large volume of student traffic in the area. This should include the floors and walls.
4. The lobby area is one of the most visible and heavily used portions of the building. For this reason, the aesthetics of the lobby should be considered an important element in the design of the area, along with the need for durability.
5. Vending machines should not be located in the lobby area and should be as remote as possible if not completely eliminated.
6. Trash/recycling containers in the lobby area should integrate with the overall aesthetic treatment of that lobby area.
7. Restrooms are needed in the vicinity of the lecture hall, but in no case should there be a common wall between the restrooms and the lecture hall.

### **N.13 DIMENSIONS OF LECTURE HALLS**

- A. Large lecture halls (those seating more than 100 students) should be a modified fan-shape. Ideally, no student should be more than 45° off the center axis of the room. The depth of the room should not be greater than one and one-half times the width of the room, measured at the midpoint of the seating area (refer to page N-23).
- B. If the lecture hall has a sloped floor, the incline should be no more than 1:12. If there is a difference of four (4) inches or less between each row, then the seating should be staggered to permit clear visibility to the front of the room.

Small lecture halls (under 100 – student capacity) may or may not have a sloped floor. If the floor is flat, a teaching station platform should be installed in the front of the room to improve sight lines between the instructor and the students. In most instances, a six-inch high platform is sufficient. The platform should be wheelchair accessible and be large enough to accommodate necessary instructor furniture and equipment.

- C. Aisles in a lecture hall should be laid out to provide the maximum of prime viewing locations for the audience. Generally, this will mean no center aisle. Building codes must be consulted in determining the number of seats in a continuous row and the distance between rows allowed in the location where the lecture hall is being built.
- D. There should be no posts or other obstructions anywhere inside a lecture hall that would obstruct the view from any seat.
- E. Special attention should be given to the amount of space available at the instructor area for chalkboard/markerboard and for other visual presentations. This emphasis, particularly in large lecture halls, should be on the use of projection tools in the place of the chalkboard/markerboard in order to provide for maximum visibility to students throughout the lecture hall.
- F. Ceiling heights will vary, depending upon the size of the room. The following are recommended minimum ceiling heights, based on the number of student stations within the lecture hall. Higher ceilings may be needed if the lecture hall will have video projectors that are ceiling mounted.

<u>Capacity</u>	<u>Rear Ceiling Height</u>	<u>Front Ceiling Height</u>
75-149	8 feet	12 feet
150-299	8 feet	15 feet
300 or more	8 feet	18 feet

- G. Walls in the lecture hall, ideally should not be parallel, or have long smooth surfaces. These construction features relate to acoustics in the lecture hall.

**N.14 ENTRANCES AND EXITS IN THE LECTURE HALL**

- A. At-grade access should be provided to the front area of large lecture halls which have sloped floors. This access is to facilitate entering/exiting of wheelchair users as well as the movement of equipment.
- B. The principal entrances/exits for large lecture halls should be in the rear section of the room.
- C. Entrances and exits should facilitate the easy access of people with disabilities.
- D. Locks should be key-activated only with classroom function hardware.

**N.15 WINDOWS FOR THE LECTURE HALL**

Large lecture halls should be void of windows. In cases where lecture halls have windows, they should be treated with blackout blinds with rails on all sides.

## **N.16 FINISHES FOR THE LECTURE HALL**

### **A. Floors:**

It is recommended that the floors be covered with resilient tile.

If a concrete floor is used in the student seating area, it should be sealed and/or painted.

### **B. Walls:**

Walls should be constructed of a durable material and include acoustical treatment where prescribed by an acoustical consultant.

### **C. Ceilings:**

The single most important characteristic of the ceiling in a large lecture hall is its role in the overall acoustical treatment of the room. Other characteristics of the ceiling that should be considered are a light color and non-reflective material so as to remain neutral in the lighting scheme of the room.

## **N.17 ACOUSTICS FOR THE LECTURE HALL**

A. Acoustical characteristics of a lecture hall are among the most critical elements in the design of the facility. Care must be exercised in isolating the facility from exterior noise as well as controlling the background noise level in the room, especially that generated by the mechanical systems. Ambient sound levels measured at four (4) feet above the floor at all points throughout the room must have a Noise Criterion (NC) rating of more than 35.

B. The mix of sound-reflectant and sound-absorbent materials must be carefully calculated to control reverberation without creating a sound-deadened room. It is strongly recommended that an acoustical consultant be included in the design team for lecture halls.

### **C. Walls:**

Walls should have a Sound Transmission Coefficient (STC) rating of no less than 50. Walls must extend to the floor above or to the roof construction, and not stop at the ceiling.

### **D. Ceilings:**

1. Ceilings should be sloped or stepped and primarily of a hard surface. If it is determined that some acoustical treatment is needed as part of the ceiling, it should be installed around the perimeter of the sides and rear in the form of a U, with the front and middle sections of hard-surfaced, sound-reflectant materials. Acoustical treatment normally will not exceed 40-50 percent of the ceiling surface.

2. Partial wall-surface treatments should be considered as an alternative to ceiling treatment. The back wall may need to be 50-100% covered with acoustical absorption materials.

- E. Mechanical Systems:
1. The mechanical system should generate a background noise of no more than NC 15-20. The system requires careful design, competent installation and balancing, and a regular maintenance program once installed.
  2. Factors that have been identified in the design of a quiet operating system include air handlers or fans located away from the lecture hall; low velocity of air within the lecture hall; and proper sizing and acoustical treatment of ducts, returns, an diffusers.

## **N.18 LIGHTING AND LIGHTING CONTROLS FOR THE LECTURE HALL**

- A. Lighting in large lecture halls is particularly critical element, because of the increase of educational technology in teaching. It is essential that the lecture hall have a full range of capabilities, from a comfortable reading level of light to a minimum level of light needed for note-taking during projection. It is essential that lighting controls be designed for use by instructors whose first concern is the communication of content rather than the operation of equipment.
- B. Controls:
1. Controls for the house lights in lecture halls are needed at every entrance into the room. A complete set of controls should be available at the instructor area. The number of switches required to control the room should be kept at a minimum and should be clearly labeled. Standardization among lecture halls is recommended.
  2. If the lighting controls are preset controls, then a manual override should be readily available. In addition, both the preset and the manual override should be clearly labeled and simple to use.
- C. Ceiling Lighting:
1. A general lighting level of 50-60 foot-candles should be provided at all student stations within the room.
  2. Lighting in the student and instructor areas should be on separate zones. It should be possible to switch zones of ceiling lighting from the front to the rear of the room so as to maintain full light level in the rear of the lecture hall while reducing the light level in the front when using various projection devices at the front of the room (such as overhead projectors). Light level at the screen is to be no greater than one (1) foot candle.
  3. While zoning addresses one (1) type of lighting control, dimming also will be needed. For certain types of projection, it should be possible to reduce the lighting level to 5-10 foot-candles over the student stations, with no lighting onto the walls, the instructor area, or projection screen.
  4. Fluorescent lights should be three (3) lamps with two (2) lamps switched together and the center lamps switched separately. Dimmable fluorescent lights are not be used.



5. A work light must be provided in the instructor area with care given that the light does not spill onto the projection screen. Provision for lighting must also be made for a person who is providing sign language interpretation to hearing-impaired students.

D. Chalkboard/Markerboard Lighting:

Lighting providing 75 foot-candles of uniform light across the writing surface, chalkboards/markerboards. This lighting should be designed so as to avoid any bright spots or dark spots on the writing surface. If the lecture hall is designed with a large amount of chalkboard/markerboard, the lights over the writing surface should be able to be switched on and off in sections to allow for the illumination of a portion of the board while one (1) projection screen is in use. Care should be taken in selection and installation to insure that lamps in the fixtures are not directly visible to students sitting in the front row of seats.

E. Other considerations:

Emergency lighting, aisle lighting, and exit signs should conform to local codes. Insofar as possible, these should be located so as not to interfere with the quality of the image on the projection screens or provide visual distraction to the audience. Lighting should be controlled by a 60-minute timer switch.

## **N.19 ELECTRICAL AND COMMUNICATION SERVICES FOR THE LECTURE HALL**

A. Electrical Services:

1. It is essential that lecture halls be provided with ample electrical power to meet present-day needs as well as have additional power available for future applications. It is recommended that a minimum of 20 percent, and ideally as much as 40 percent, expansion in electrical service be made available at the time of new construction or major renovations.
2. Electrical services should be protected from surges and spikes.
3. Each lecture hall should have a minimum of two (2) dedicated 20 amp circuits with separate breakers controlling the service exclusively to the lecture hall. One (1) of these should feed the front portion of the room and the second, the media closet.
4. The front of the lecture hall should be equipped with a minimum of four (4) duplex outlets distributed evenly across the instructor area. In addition, two (2) duplex outlets should be located in each of the other walls. At least two (2) fourplex outlets should be located in the media closet. If a ceiling mounted video projector is to be used, electrical service is needed at the projector and controlled at the instructor area.

B. Telecommunications:

1. Voice, video and data services should be provided from a telecommunications closet to the lecture hall. It is recommended that all of these services serve the front of the room and the media closet, or media cabinet.

2. It is recommended that video, data, and electrical services be provided in the ceiling of the room to facilitate the installation of a video projector. To accommodate current technology, that termination box should be at a distance from the principal projection screen one and one-half times the width of the projection screen, or as recommended by the University's Media Specialist.
3. Although the specific location of conduits or cable trays will vary depending on the design of the lecture hall, in general connections are needed: from the instructor area to the media closet, from the instructor area and media closet to the video projector, if it is ceiling mounted, from the front of the instructor area to the podium. If it is anticipated that the instructor podium be movable, then connections should be provided at the right, left, and center of the instructor area. Some provision for telecommunication and electrical outlets in the student seating area may be desirable to accommodate computers, recording devices, response systems, etc.
4. Projection enclosure for video project, is to be located at the rear of the classroom. The enclosure will have adequate ventilation. Entire enclosure will be constructed with heavy wire fabric or expanded metal to provide security. Give the amount of equipment installed, doors will have mortise locks.
5. See insert -- Cable Schematic riser.

#### **N.20 MEDIA CLOSET FOR THE LECTURE HALL**

- A. Lecture halls will contain a secure media closet to contain the electronic equipment and rack. The closet will be approximately 48" x 48" inside, lined with 3/4" plywood or expanded metal and drywall with a lockable 3/4" plywood door and 1 3/4" solid core wood outer door with mortise hardware.
- B. There will be a monitor of the house audio system, including voice-amplification system in the media closet or instructor's console. The closet and/or console should include controls for audio, lights, screens, and other projection equipment.
- C. The media closet will have adequate ventilation, through the top of the closet. The ceiling will be constructed of heavy welded wire fabric 4" x 4" x12, or expanded metal to also provide security.
- D. Security is a major concern, given the amount of equipment installed in media closets and consoles. Doors will have mortise locks or equipment.

#### **N.21 FURNISHINGS AND EQUIPMENT FOR THE LECTURE HALL**

- A. Instructor Area:
  1. Media needs dictate the installation of a teaching podium or console at the front of the room that serves as the master control center for the room. Instructors in wheelchairs should be able to access any controls provided. In addition, a free-standing podium with a 24" d. x 30" w. surface should be provided with a light and microphone.
  2. The podium should have a variety of communication and control capabilities, including electrical outlets; voice, video, and data outlets; controls for the lights

and the projection screen(s); controls for the voice amplification system, including a microphone; and controls for equipment built into the room and media closet.

3. The dimensions of the podium for a lecture hall should be 24 inches to 36 inches deep with the width determined by the equipment and controls to be housed. The height should be no more than 42 inches from the floor and coordinated with the height of the chalk/marker tray.
4. Size and placement of the podium are critical. Neither the podium nor the faculty member standing at the podium should block students' view of the projection screen(s) or the chalkboard/markerboard. An overhead projector should be able to be positioned close to the podium and at a sufficient distance from the screen to provide an acceptable image size.
5. If the podium is to contain equipment that is permanently housed in the room, it should be constructed of materials and using methods that provide the maximum security for the equipment housed within the podium.
6. The chair or stool for the instructor should be of adjustable height in order to make it convenient for the instructor to use all types of teaching devices.
7. A voice communications device should be located either in the podium or in the immediate vicinity of the teaching station.

B. Student stations:

1. Fixed seating:

- a. It is recommended that rooms seating more than 75 have fixed seating. There may be special occasions when a small lecture hall, 75-100 students, would best be served by the use of movable seating. This is the exception, however, and will present operational problems because of the difficulty of keeping a large number of movable seats in reasonable order.
- b. Whenever possible, it is recommended that continuous tables with fixed chairs be installed in lecture halls. This provides the student with the maximum work area.
- c. When fixed chairs with tablet arms are used, the tablet arm should have a minimum of 150 square inches of writing surface. The arm also should fold to facilitate passage of students through the rows of seats. Fixed tables and chairs attached directly to the floor should have exposed bolt heads covered.
- d. Since the number of seats in each row and the relationship of this number to the aisles are often covered by code requirements, these should be consulted in determining the layout of a room.

2. Left- Handed Seating:

A minimum of ten percent left-handed tablet arms is needed.

3. Wheelchair Stations:

Seating for mobility-impaired students should be provided in lecture halls at approximately four percent of the capacity of the room. To accommodate students in wheelchairs, a table 30 inches deep, 31 inches high (with 29 inches clearance), and 36 inches wide is recommended.

C. Chalkboards/Markerboards:

1. Chalkboard/markerboards shall be provided in the instructor area of large lecture halls. While instructors using large lecture halls should be encouraged to use the overhead and other projection devices, there are occasions when a chalkboard/markerboard is essential to effective use of the room.
2. Chalkboard/markerboards shall be mounted with the bottom edge of the chalk/marker tray 36 inches above the finished floor. In a room which has a raised teaching platform, the distance should be from the bottom of the chalkboard/markerboard to the teaching platform, not to the floor.
3. Chalkboards/markerboards should be four (4) feet in height and have chalk trays under the full width of the board. Seams of the boards should be flush, and, in the case of chalkboards, the surface should provide maximum contrast with the chalk or marker being used.
4. It is recommended that tack strips and map hooks be installed above the chalkboard but that no tack board be included as part of the instructor area in lecture halls.

D. Audio:

1. Voice Reinforcement:

- a. Voice Reinforcement should be installed in lecture halls. The microphone and volume control for the amplification system should be easily accessible. Other settings, such as tone and balance, should be available only to a technician.
- b. It is recommended, where technically feasible, that a wireless microphone be installed to allow the instructor the maximum flexibility of movement throughout the lecture hall.

2. Program Reinforcement:

- a. Unless a technician is assigned permanently to support instruction in the lecture hall, a program reinforcement system separate from the voice amplification system should be installed to handle other sound sources. The system should be capable of amplifying the soundtrack of films, audiotape, and other audio sources such as compact discs, videotape, video discs, and voice coming in via telephone lines. Distribution from the system can be fed into speakers properly mounted and spaced to provide total coverage within the lecture hall.
- b. The sound system also should be wired into at least two (2) locations in

the lecture hall to provide for students with hearing-impairments.

E. Projection Screen:

1. Lecture halls require multiple screens, the number dictated by the design of the facility and by the special uses for the facility. The minimum recommended number of screens is two. These should be mounted above the chalkboard/markerboard if the design of the lecture hall permits. The screens should be placed in such a way that at least six feet of chalkboard/markerboard is exposed when the screen is in use.
2. Screens should be motorized with rocker switches located both in the front of the room or console.
3. Screens are to provide acceptable picture quality up to 45° on either side of the center line of the room. No seating in a lecture room should be more than 45° off the center line.
4. Optical projection (films and slides), have very high-resolution images, resulting in a formula of instance from the screen to the farthest viewer of six times the screen width (6W).
5. With the introduction of electronic projection, however, a new screen-size standard must be applied. Electronic projection systems provide anywhere from 12.5-25 percent of the resolution of optical projection. This is particularly critical in computer-image projection, which is often comprised of text. This lower resolution results in a loss of sharpness in edge definition. At marginal viewer distance from the screen, the letters tend to blur and fill in, resulting in reduced readability.

F. Video and Data Projection Equipment:

1. Lecture halls will contain the capability of projecting both video and data.
2. Equipment will be coordinated through the University's Center for Instructional Development and Distance Education (CIDDE).

**N.22 OTHER SPECIAL CONSIDERATIONS FOR THE LECTURE HALL**

A. Storage/Preparation Area:

Considerations should be given to providing secure storage in the immediate vicinity of a lecture hall where instructors can keep materials needed on a repeated basis as well as provide space for the preparation of lecture materials.

B. Signage:

Signage in and around a lecture hall should be kept at an absolute minimum and should be incorporated into the lobby and the lecture hall when the facility is designed.

C. Environmental Issues:

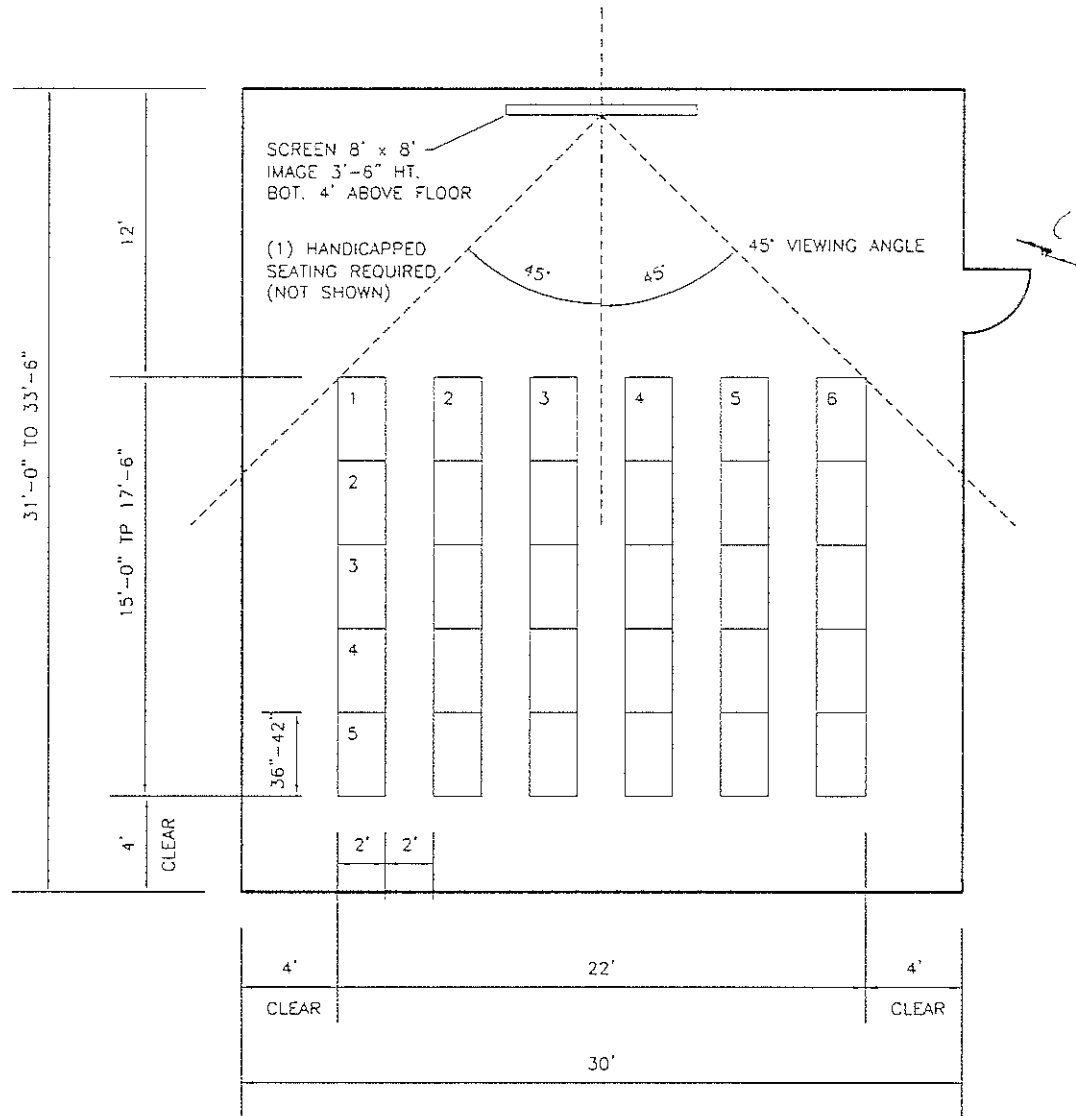
1. The heating, ventilating, and air-conditioning (HVAC) system must provide

adequate air changes in conformance with current American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE).

2. The temperature range should be maintained within 68-75°, with humidity at 50 percent, plus or minus 10 percent.
3. Each lecture hall should have a temperature-sensitive monitoring device within it and that device should be tied into a central monitoring system.
4. Acoustical considerations in determining the volume of air-handling noise should include not only the background noise level by any vibration considerations that would generate additional noise.

**END OF DIVISION**

# CLASSROOM 25 TO 30 CHAIR-DESK/TABLET ARM SEATING

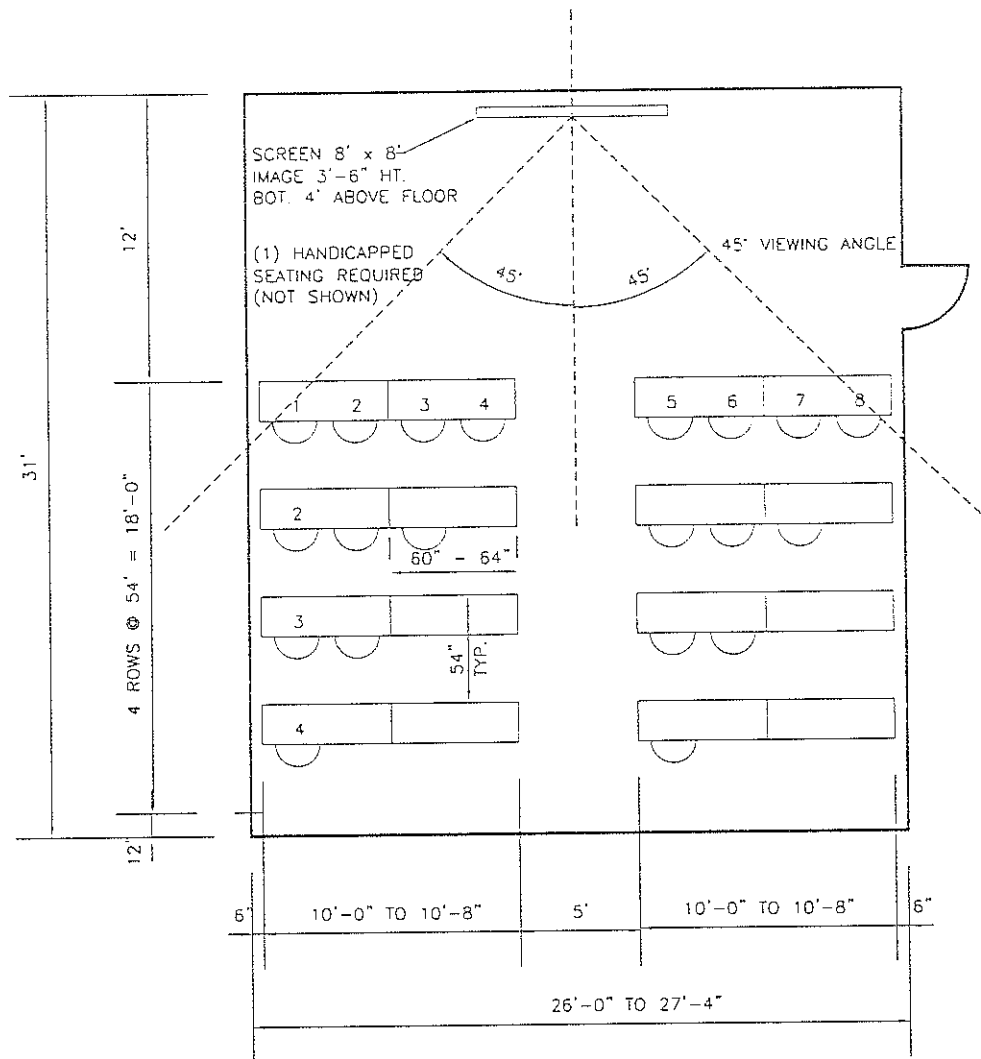


## PLAN

SCALE: 1/8" = 1'-0"

25 TO 30 SEATS CHAIR-DESK/TABLET ARM  
 330 TO 385 SQ. FT. SEATING AREA = 11 TO 15.4 SQ. FT. PER SEAT  
 930 TO 1005 SQ. FT. ROOM AREA = 31 TO 40 SQ. FT. PER SEAT  
 CEILING HT. 10'-0" TO 12'-0"

# CLASSROOM 25 TO 32 TABLE & CHAIR SEATING



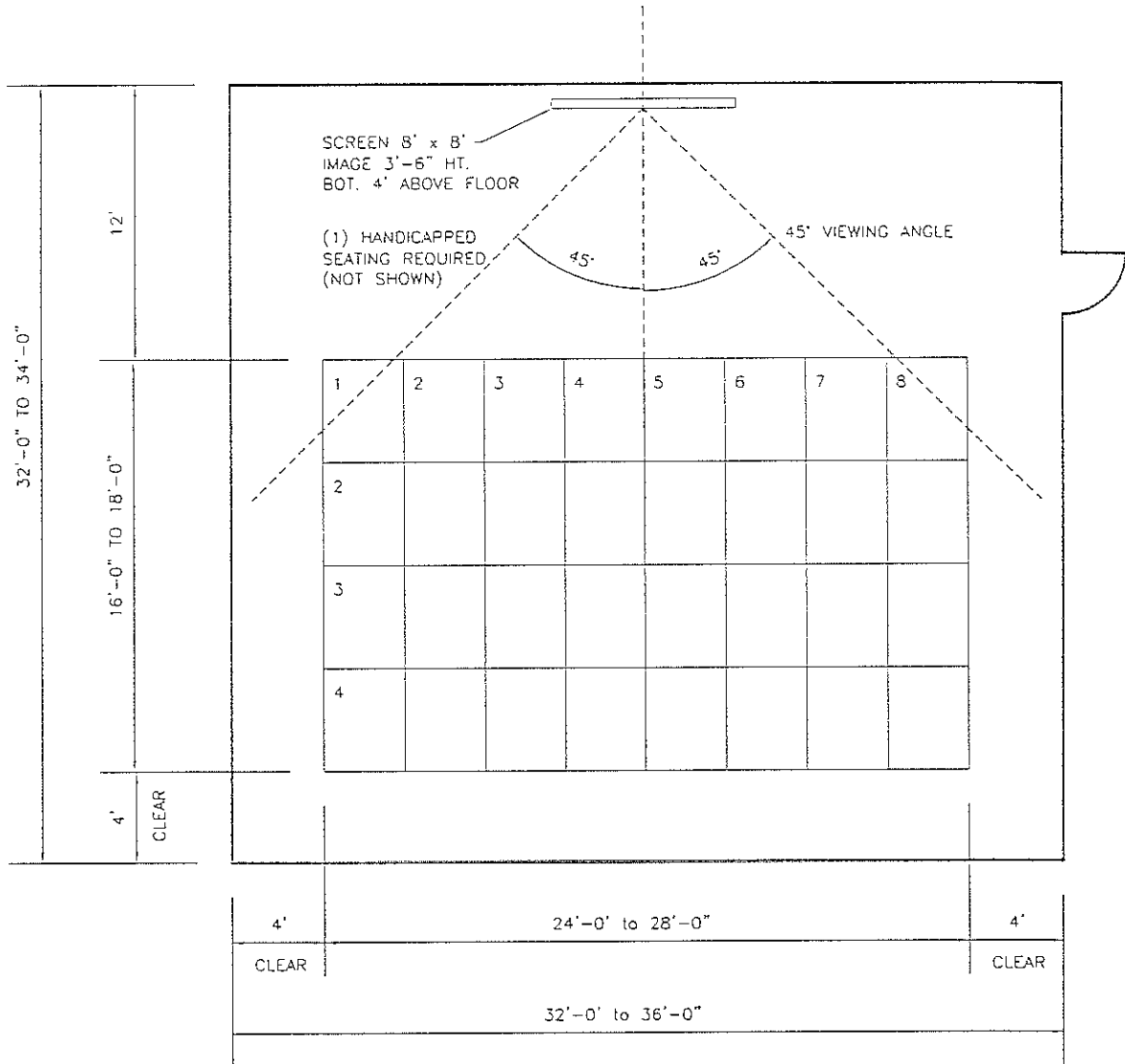
## PLAN

SCALE: 1/8" = 1'-0"

25 TO 32 SEATS      TABLE WITH CHAIRS  
 360 TO 385 SQ. FT.      SEATING AREA = 11.25 TO 15.5 SQ. FT. PER SEAT  
 805 TO 850 SQ. FT.      ROOM AREA = 25 TO 34 SQ. FT. PER SEAT  
 CEILING HT. 10'-0" TO 12'-0"



# CLASSROOM 25 TO 32 CASTER CHAIR/TABLET ARM SEATING

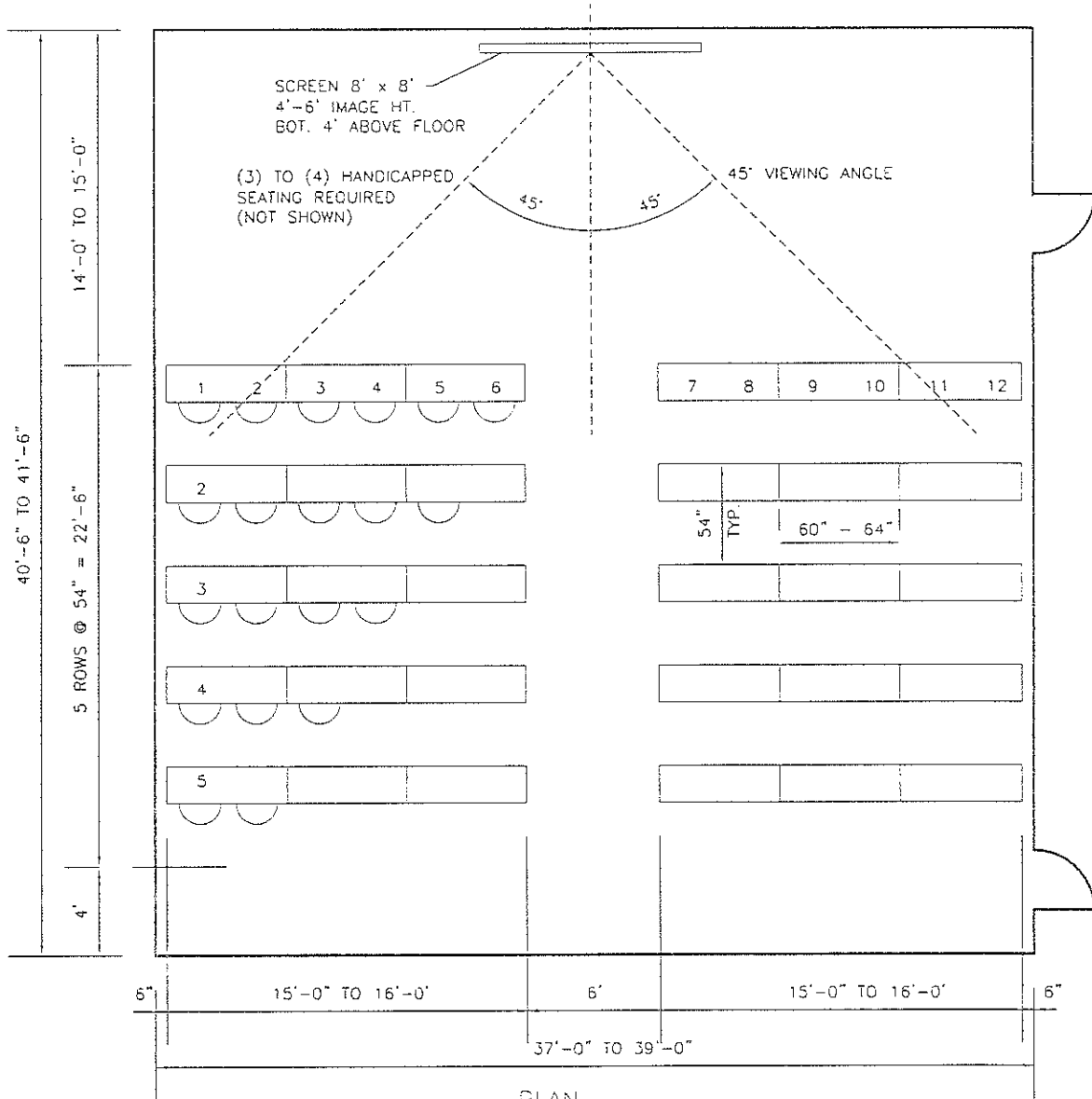


## PLAN

SCALE: 1/8" = 1'-0"

25 TO 32 SEATS. CASTER CHAIR TABLET ARM  
 510 TO 650 SQ. FT. SEATING AREA = 12 TO 20 SQ. FT. PER SEAT  
 1025 TO 1225 SQ. FT. ROOM AREA = 32 TO 49 SQ. FT. PERSEAT  
 CEILING HT. 10'-0" TO 12'-0"

# CLASSROOM 60 TABLE & CHAIR SEATING



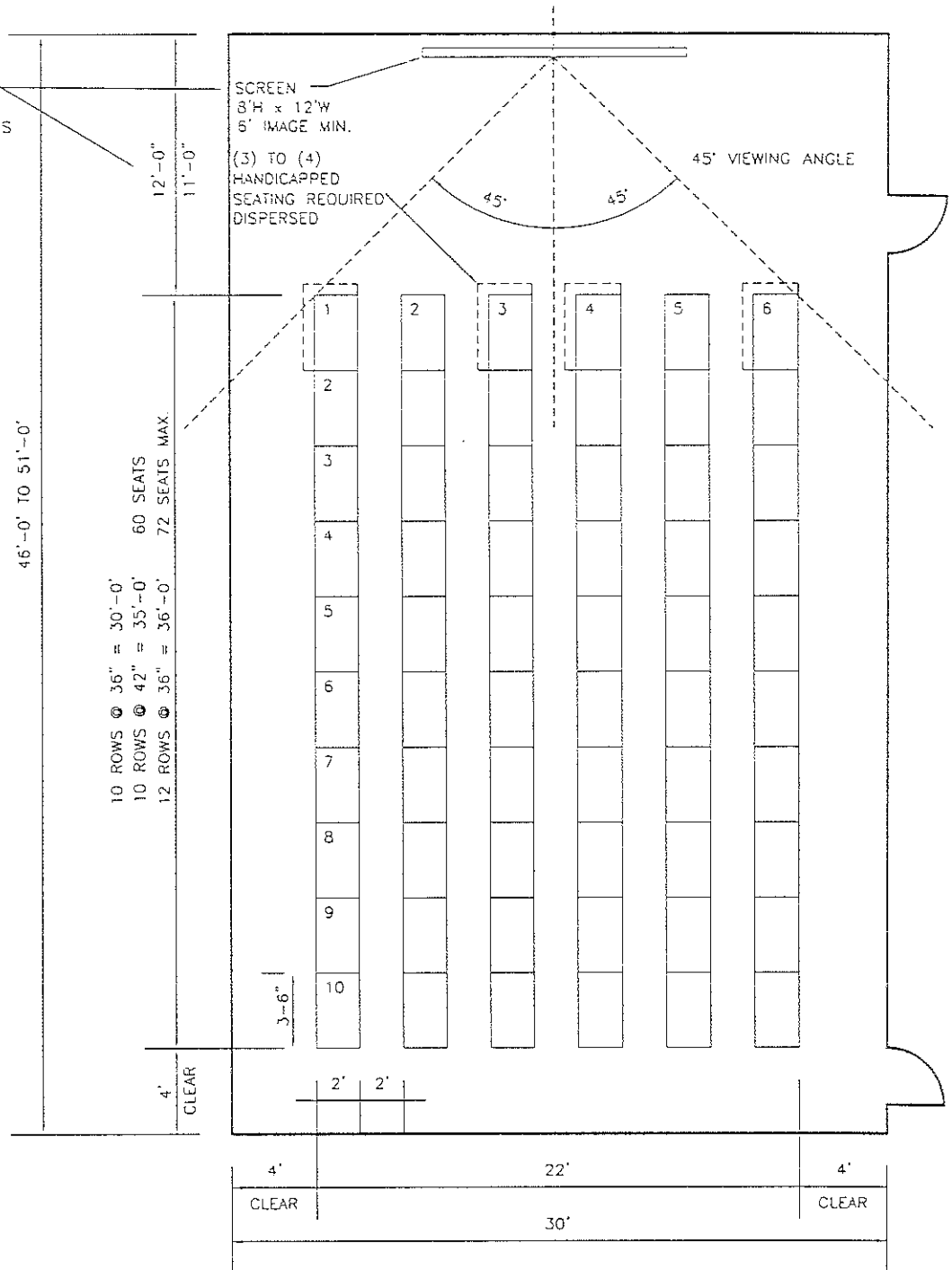
PLAN

SCALE: 1/8" = 1'-0"

60 SEATS TABLE WITH CHAIRS  
 675 TO 720 SQ. FT. SEATING AREA = 11.25 TO 12 SQ. FT. PER SEAT  
 1500 TO 1620 SQ. FT. ROOM AREA = 25 TO 27 SQ. FT. PER SEAT  
 CEILING HT. 10'-0" MIN. TO 12'-0"

# CLASSROOM 60 TO 72 CHAIR-DESK/TABLET ARM SEATING

WITHOUT AUDIO VISUAL  
SCREEN 12'-0" BECOMES  
9'-0" & ROOM DECREASES  
BY 90 SQ. FT.

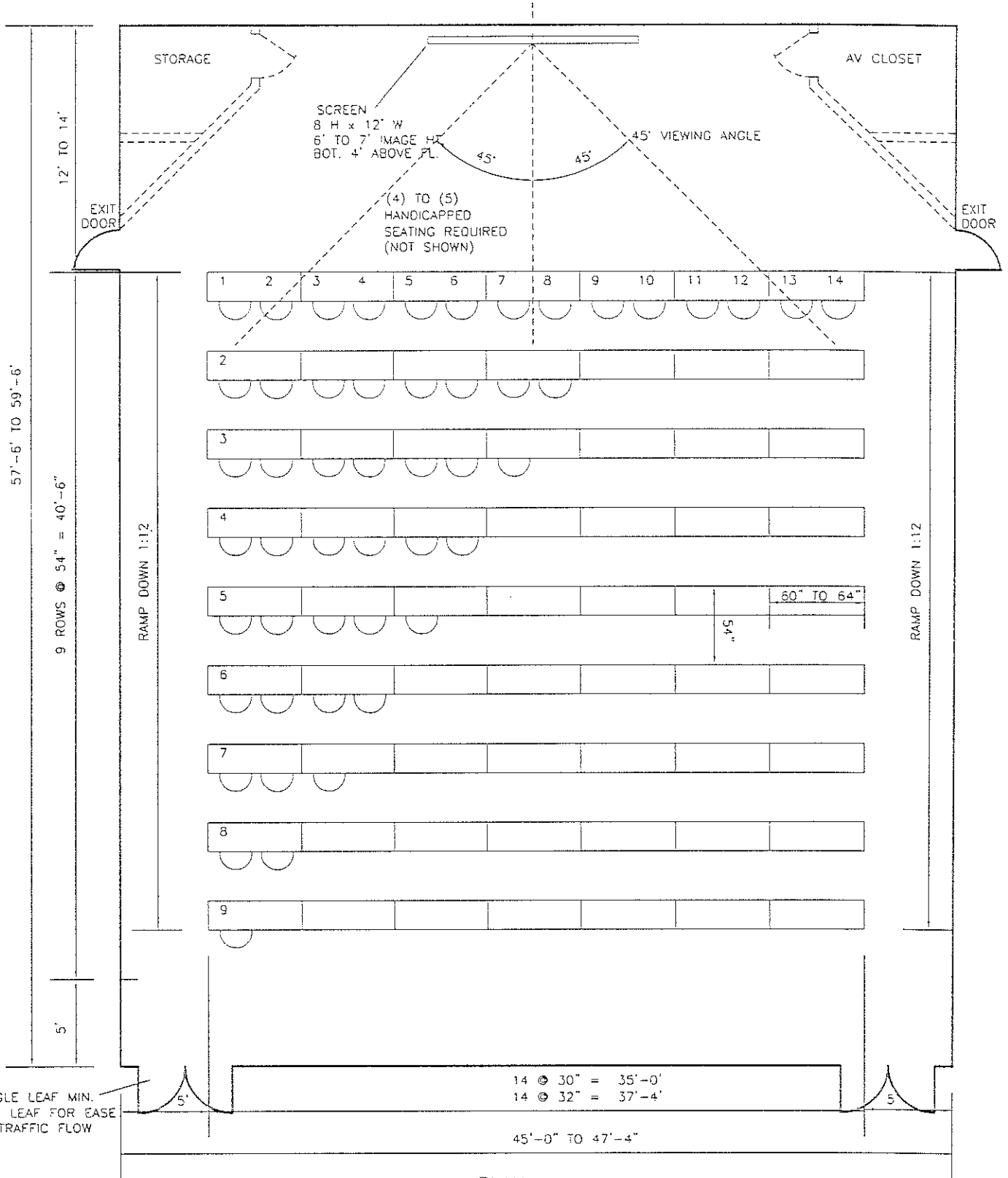


## PLAN

SCALE: 1/8" = 1'-0"

60 TO 72 SEATS CHAIR-DESK/TABLET ARM  
660 TO 770 SQ. FT. SEATING AREA = 11 TO 12.8 SQ. FT. PER SEAT  
1380 TO 1530 SQ. FT. ROOM AREA = 19 TO 25.5 SQ. FT. PER SEAT  
CEILING HT. 12'-0" MIN.

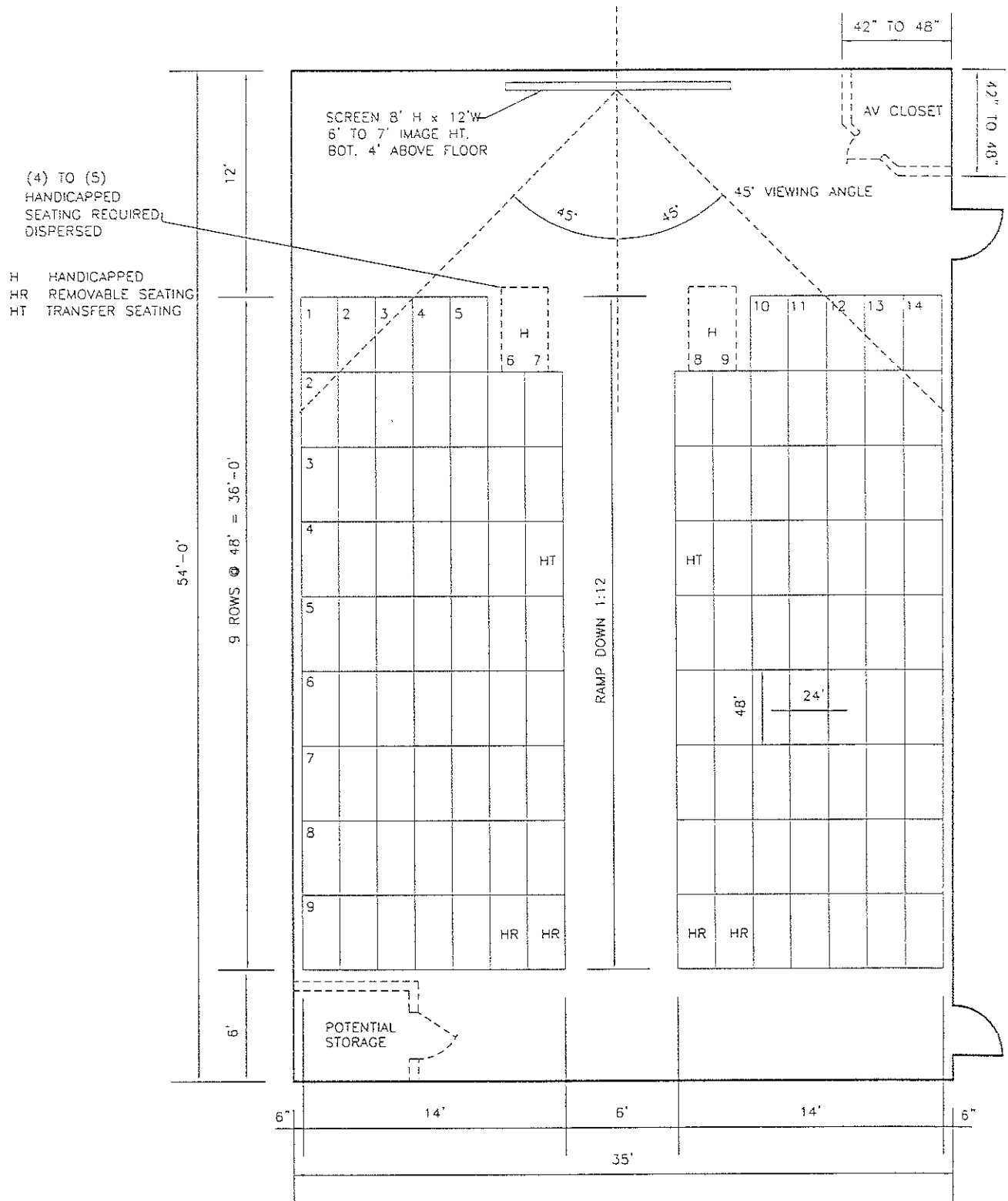
# CLASSROOM 120 TO 126 TABLE & CHAIR SEATING



**PLAN**  
SCALE: 1/8" = 1'-0"

120 TO 126 SEATS TABLE WITH CHAIRS  
 1420 TO 1515 SQ. FT. SEATING AREA = 11 TO 12.6 SQ. FT. PER SEAT  
 2590 TO 2820 SQ. FT. ROOM AREA = 20.5 TO 23.5 SQ. FT. PER SEAT  
 CEILING HT. 13'-0" MIN. @ FRONT

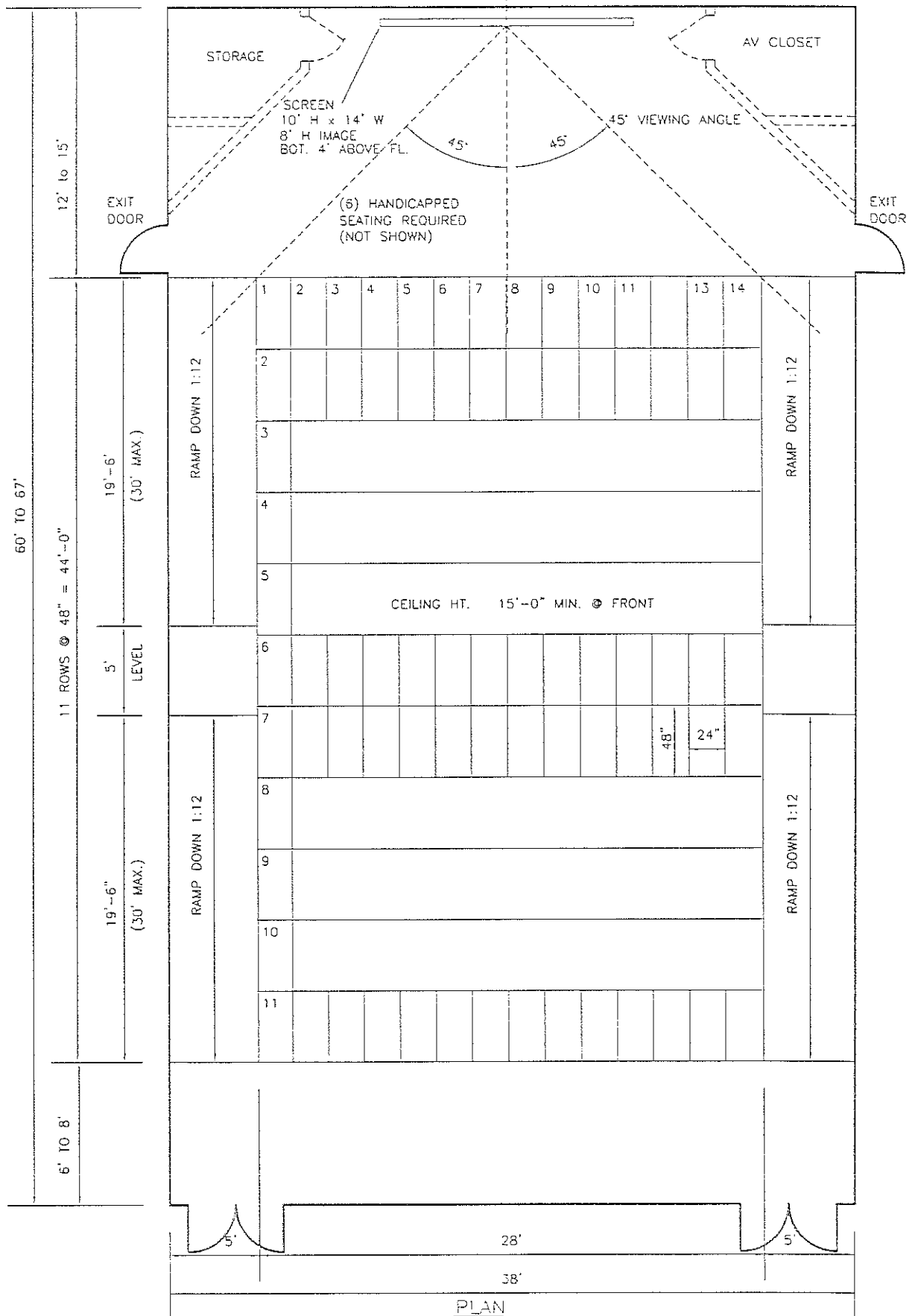
# CLASSROOM 120 TO 126 AUDITORIUM/TABLET ARM SEATING



PLAN  
SCALE: 1/8" = 1'-0"

120 TO 126 SEATS      AUDITORIUM/TABLET ARM  
 48" BACK TO BACK PERMITS PASSAGE OF SEATED PERSON  
 1008 SQ. FT. SEATING AREA = 8 TO 8.4 SQ. FT. PER SEAT  
 1890 SQ. FT. ROOM AREA = 15 TO 15.75 SQ. FT. PER SEAT  
 CEILING HT. 13'-0" MIN @ FRONT

# CLASSROOM 150 TO 154 AUDITORIUM/TABLET ARM SEATING

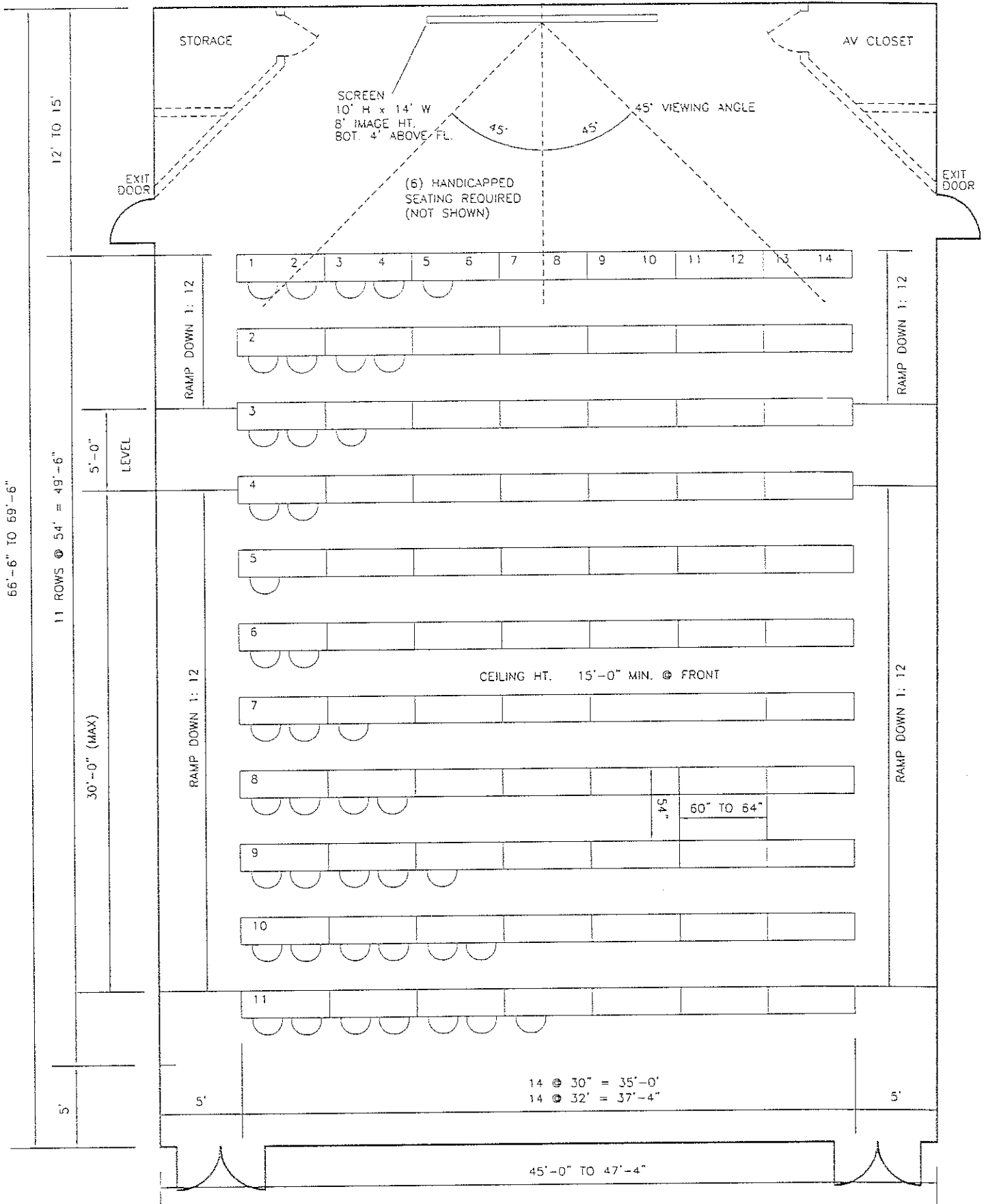


PLAN

SCALE: 1/8" = 1'-0"

150 TO 154 SEATS AUDITORIUM/TABLET ARM  
 1232 SQ. FT. SEATING AREA = 8 TO 8.2 SQ. FT. PER SEAT  
 2280 TO 2545 SQ. FT. ROOM AREA = 15 TO 17 SQ. FT. PER SEAT

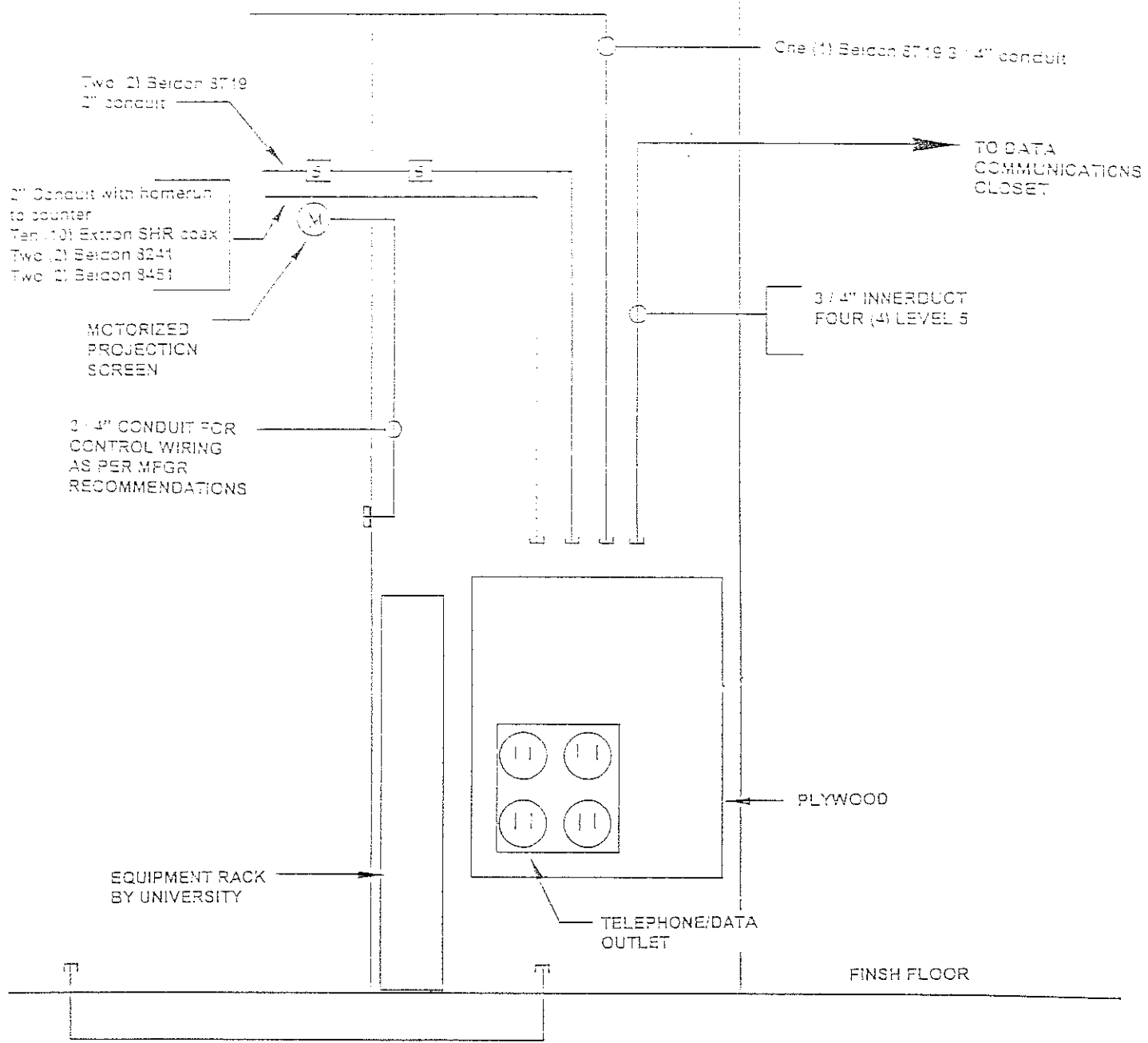
# CLASSROOM 150 TO 154 TABLE AND CHAIR SEATING



PLAN

SCALE: 1/8" = 1'-0"

150 TO 154 SEATS TABLES WITH CHAIRS  
 1730 TO 1845 SQ. FT. SEATING AREA = 11 TO 12.3 SQ. FT. PER SEAT  
 2990 TO 3290 SQ. FT. ROOM AREA = 19.4 TO 22 SQ. FT. PER SEAT



2" Conduit with  
 Ten (10) Extron SHr coax  
 Homerun to projector at ceiling  
 Two (2) Belden 8241  
 Two (2) Belden 8451  
 One (1) Belden 8723  
 Homerun to projector at ceiling  
 One (1) Belden 8457  
 Two (2) level 5 wire homerun thru  
 Media closet to Data Communications  
 Closet

AUDIOVISUAL RACEWAY & CABLE SCHEMATIC