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4

Anchorage and Installation Details

This chapter includes diagrams of example design installation methods for various types of equipment. As in Chapter 3, the subject is approached from the systems point of view. Each real installation may have its own characteristics and the suggested installation details may need modification for adequate assurance of survival. Where the installation details were developed by other authors, due credit is given to the earliest known author wherever possible. Other installation techniques are commonly found in construction practice and the author does not feel that any credit should be given. They are presented for the benefit of architects, engineers, and facility operators for use in new construction, as well as for those who may wish to upgrade existing facilities or those who are not familiar with all the commonly used details. The anchorage and bracing conditions are shown diagrammatically only. Each piece of equipment requires the entire seismic qualification process to adequately detail the installation. The use of these details will not guarantee equipment survivability and the details are not intended to represent such.

The reader will on some occasions notice that referrals from Chapter 3 lead to equipment installation details for other equipment. This approach is used to save space where the installation details are similar for different pieces of equipment. An example of such a case would be details for operating room lights and overhead X-ray equipment. Chapter 3 has entries for both pieces of equipment that refer the reader only to operating room lights in Chapter 4 because the installations are similar.

AIR HANDLING SYSTEMS

Guidelines for the installation of ducting have been prepared for the Sheet Metal Fund of Los Angeles (Sheet Metal and Air Conditioning Contractors' National Association, Inc., SMACNA) by the structural engineering firm of Hillman, Biddison & Loevenguth. They are titled *Guidelines for Seismic Restraints of Mechanical Systems* and have been approved by the California Office of the State Architect. These guidelines are reproduced in part in Appendix 3, to which the reader is referred for appropriate installation details.

DATA PROCESSING SYSTEMS

Anchorage installation details for data processing systems can be extrapolated from similar applications, such as those shown in the following sections.

- Access Floor Systems.
- Communication Systems
- Emergency Power Supply Systems.

KITCHEN SYSTEMS

Guidelines for the installation of kitchen equipment have been prepared for the Sheet Metal Industry Fund of Los Angeles (Sheet Metal and Air Conditioning Contractors' National Association, Inc., SMACNA) by the structural engineering firm of Hillman, Biddison & Loevenguth. They are titled *Guidelines for Seismic Restraints of Kitchen Equipment* and have been approved by the California Office of the State Architect. The guidelines are reproduced in part in Appendix 3, to which the reader is referred for installation details of kitchen equipment.

MOTION RESTRAINT SYSTEMS

The design team should, on every occasion, refer to the professional engineering staff of the motion restraint manufacturers when these items are required. Inappropriate installation of the motion restraints can lead to a false sense of security. Manufacturers of motion restraints are listed in Appendix 2 for the design team's easy reference.

Installing equipment that requires vibration isolation without motion restraints leads to equipment failure and can cause personnel injury or damage to other critical equipment when the springs "fly" out of their supports. Chapter 3 shows numerous occasions where cap screws sheared and spring housings broke, freeing the springs from beneath the equipment with a tremendous release of energy.

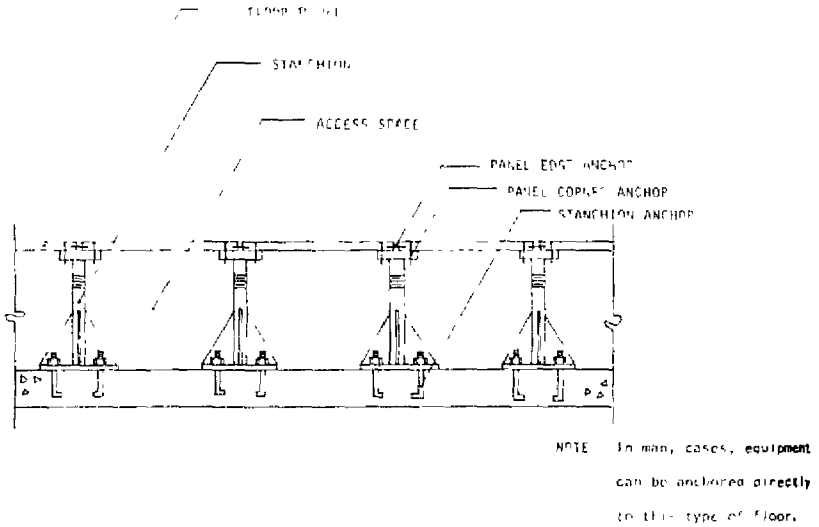


FIGURE 4.1 Access floor systems. Interlocking access floors showing floor panels, anchors, and stanchions.

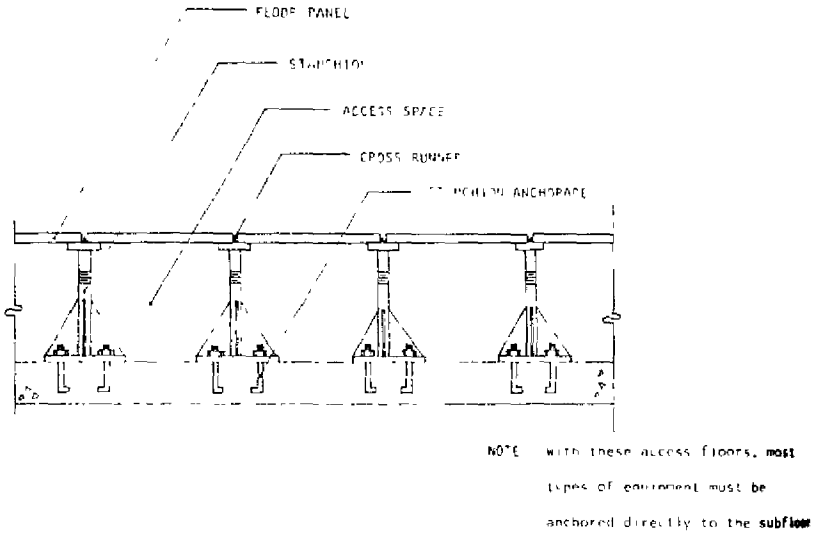


FIGURE 4.2 Access floor systems. Noninterlocking type access floors showing floor panels and stanchions.

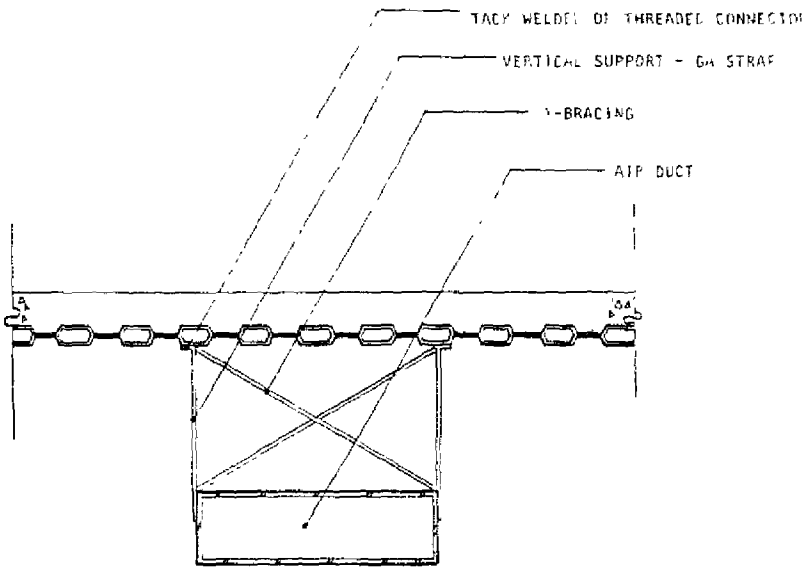


FIGURE 4.3 Air handling systems. Air duct suspension and lateral bracing.

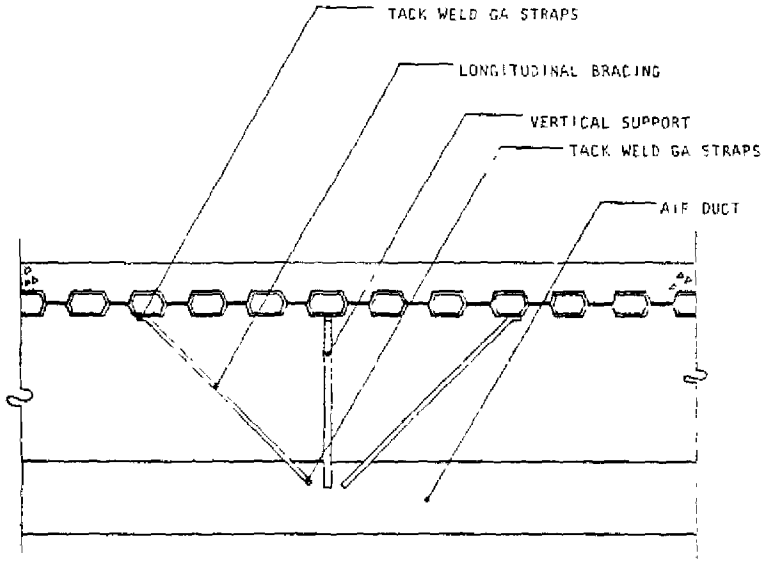


FIGURE 4.4. Air handling systems. Air duct suspension and longitudinal bracing.

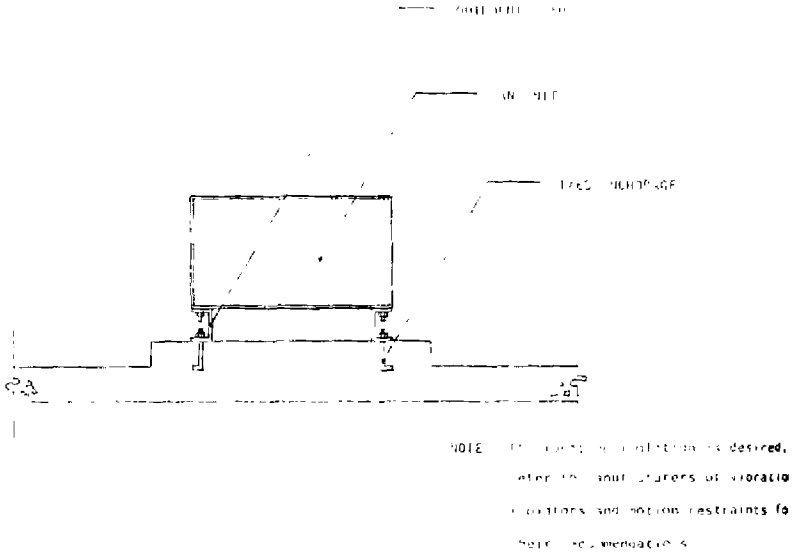


FIGURE 4.5. Air handling systems. Fixed anchorage for fan units

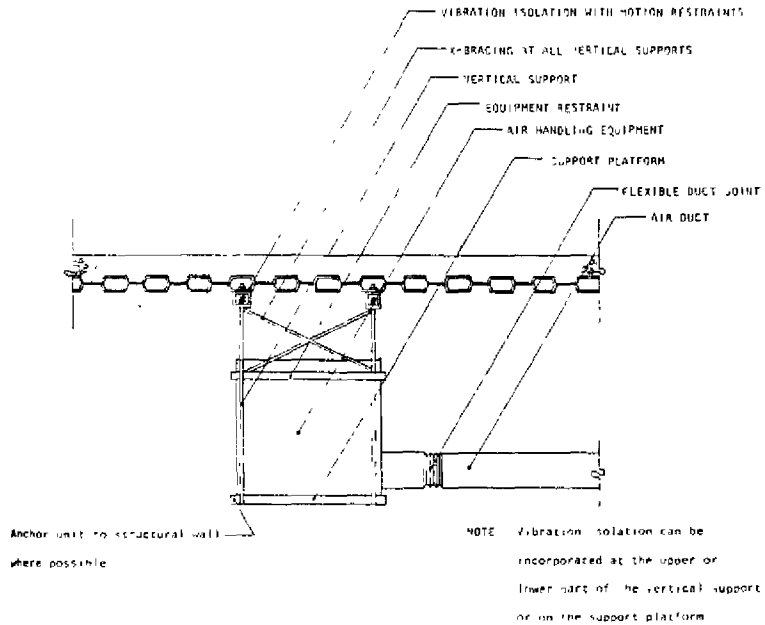


FIGURE 4.6. Air handling systems. Suspended fan unit with vibration isolation

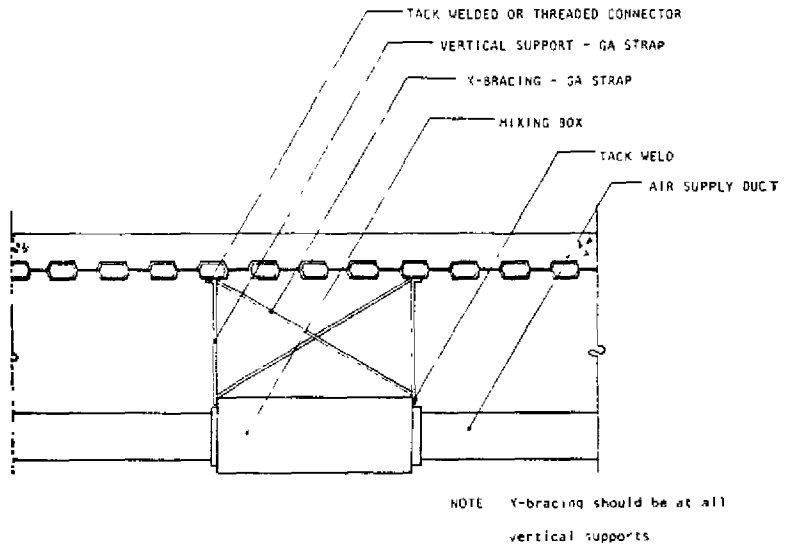


FIGURE 4.7. Air handling systems. Suspended lightweight mixing boxes with diagonal cross (X) bracing

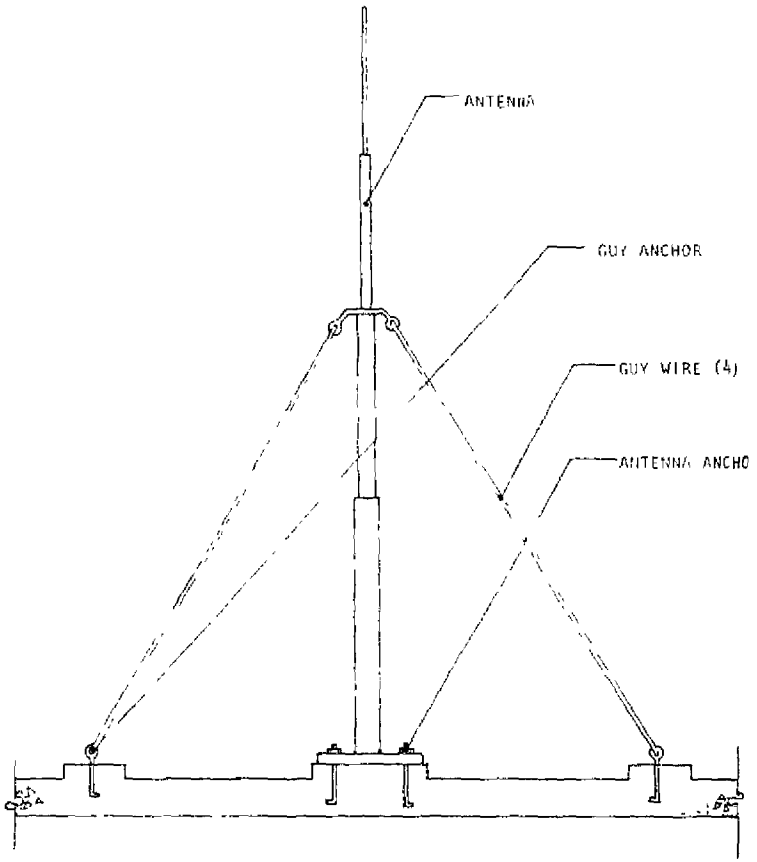


FIGURE 4.8 Communication systems Roof antenna guyed four directions mutually perpendicular 45° from horizontal

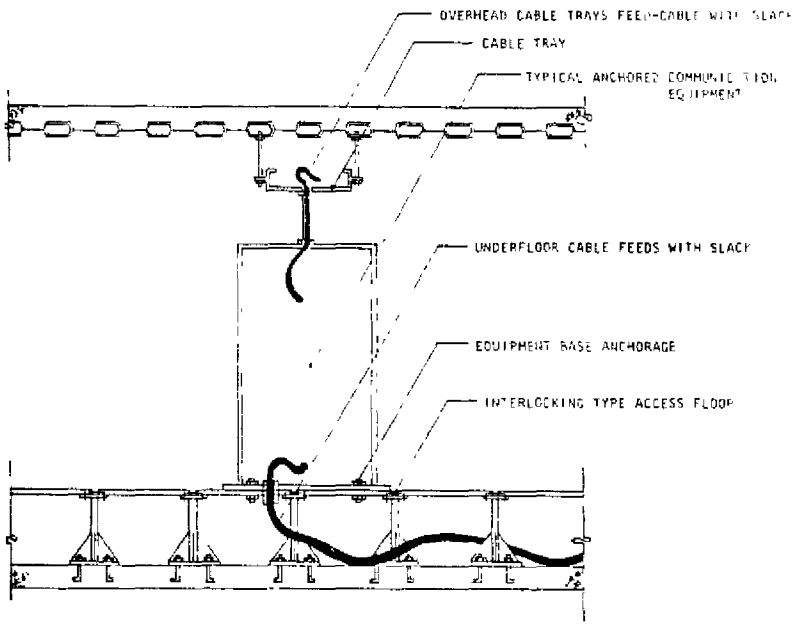


FIGURE 4.9. Communication systems Slack in electric cable installation

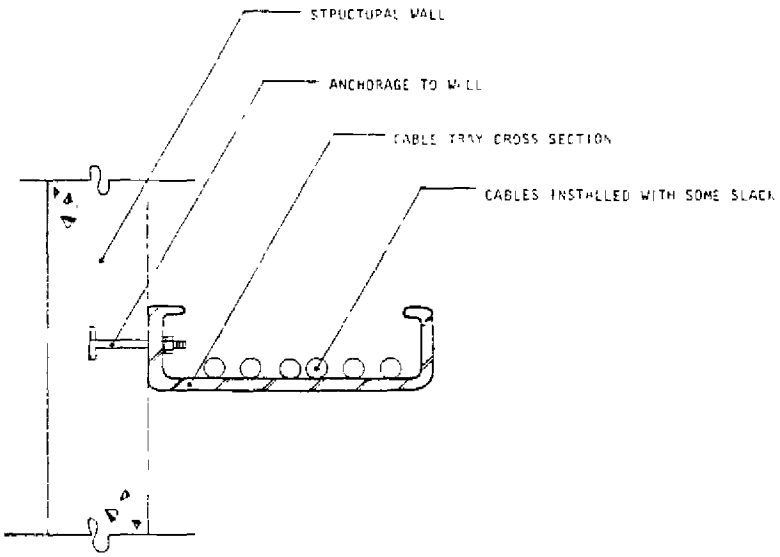


FIGURE 4.10 Communication systems Cable tray anchorage to structural wall

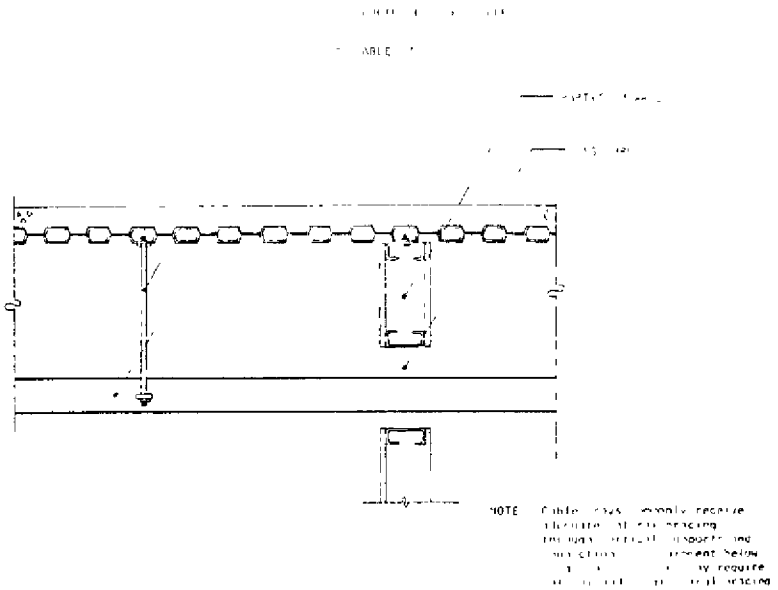


FIGURE 4.11. Communication systems. Cable trays showing pass through at partition wall.

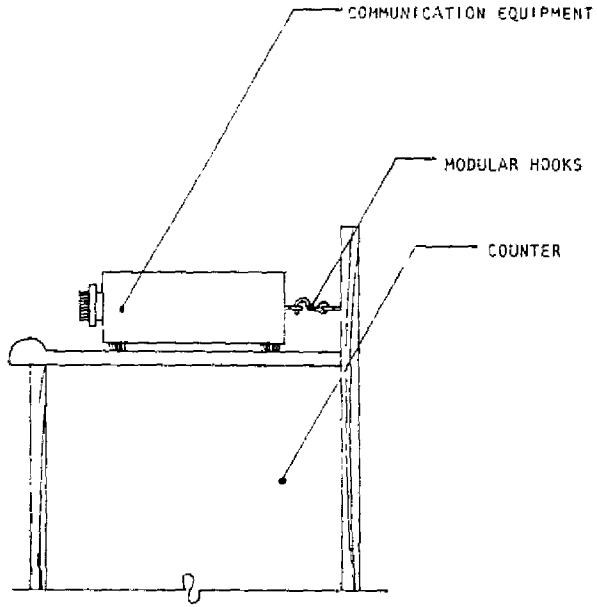


FIGURE 4.12. Communication systems. Nonpermanent counter top installation using eye hooks

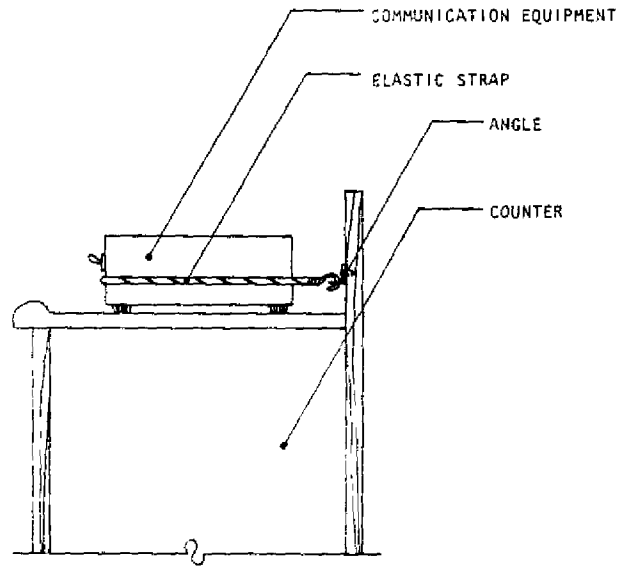


FIGURE 4.13. Communication systems. Nonpermanent counter top installation using elastic straps.

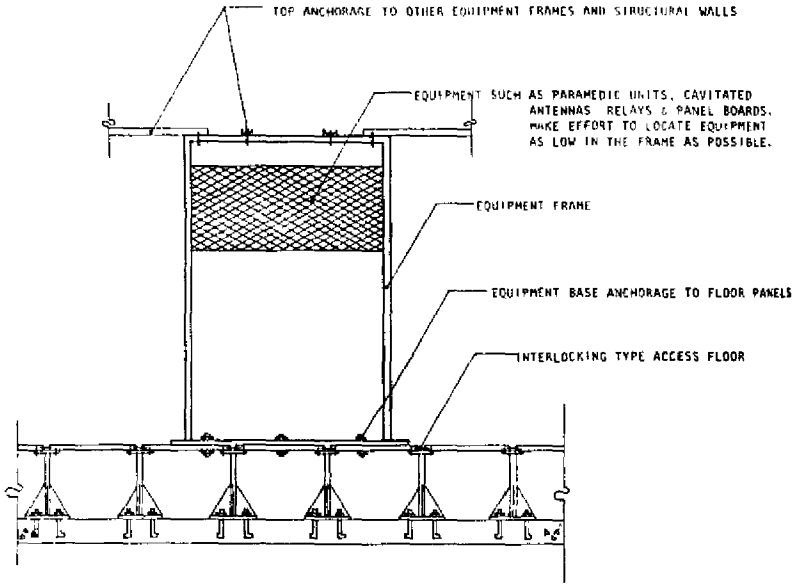


FIGURE 4.14. Communication systems. Equipment frame anchorage to interlocking type access floor

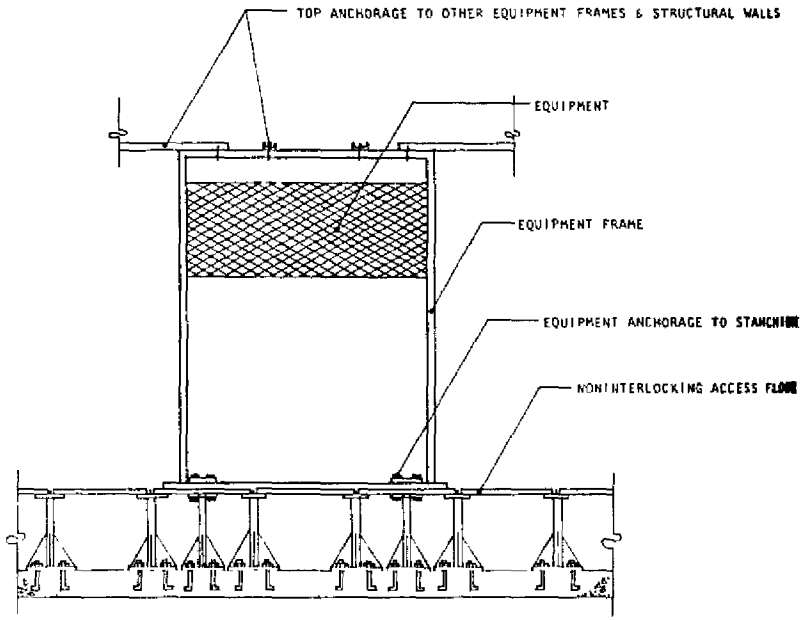


FIGURE 4.15. Communication systems Equipment frame anchorage to noninterlocking type access floor.

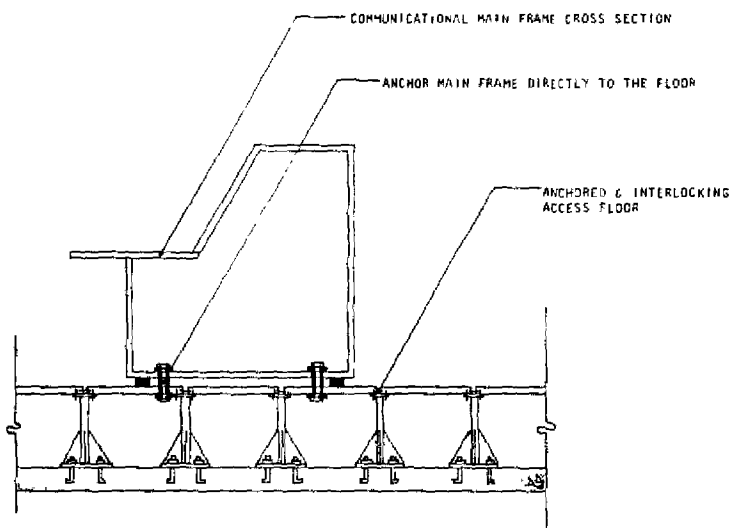


FIGURE 4.16. Communication systems Main frame installation and anchorage for interlocking access floor.

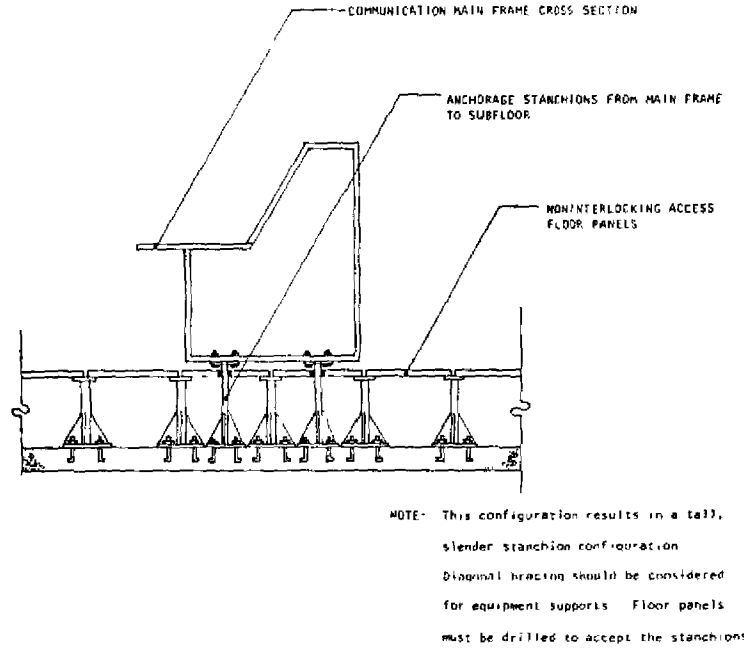


FIGURE 4.17. Communication systems. Main frame installation for noninterlocking access floor.

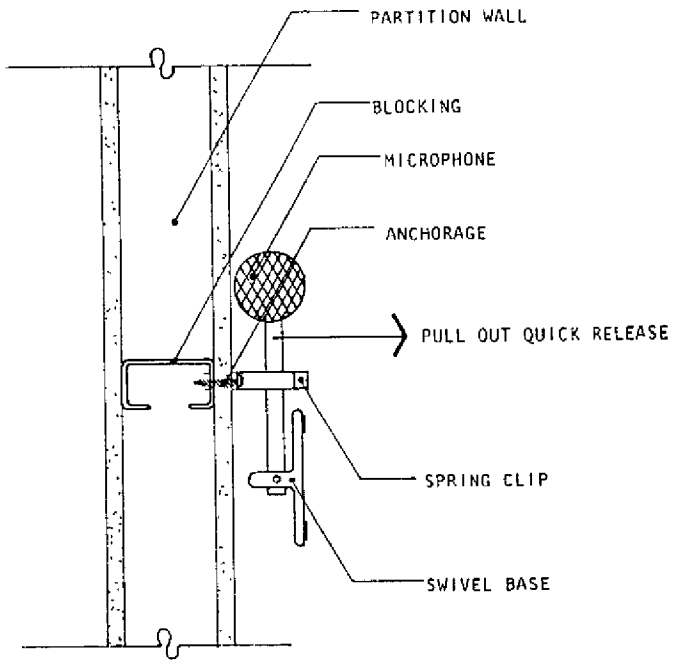


FIGURE 4.18. Communication systems. Secured microphone when not in use.

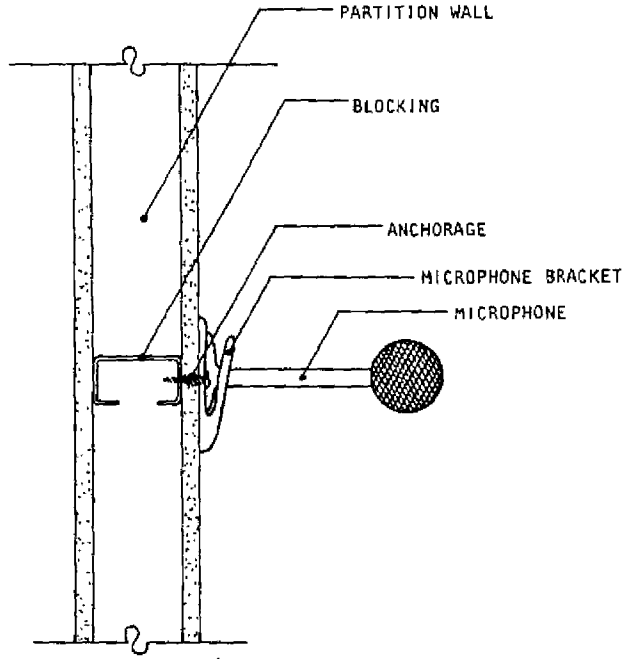


FIGURE 4.19. Communication systems. Secured microphone when not in use.

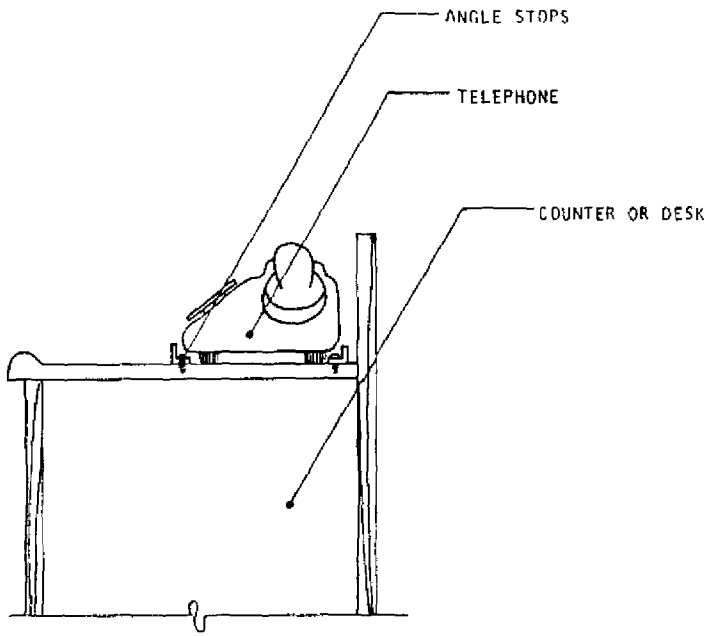


FIGURE 4.20. Communication systems. Telephone equipment anchorage.

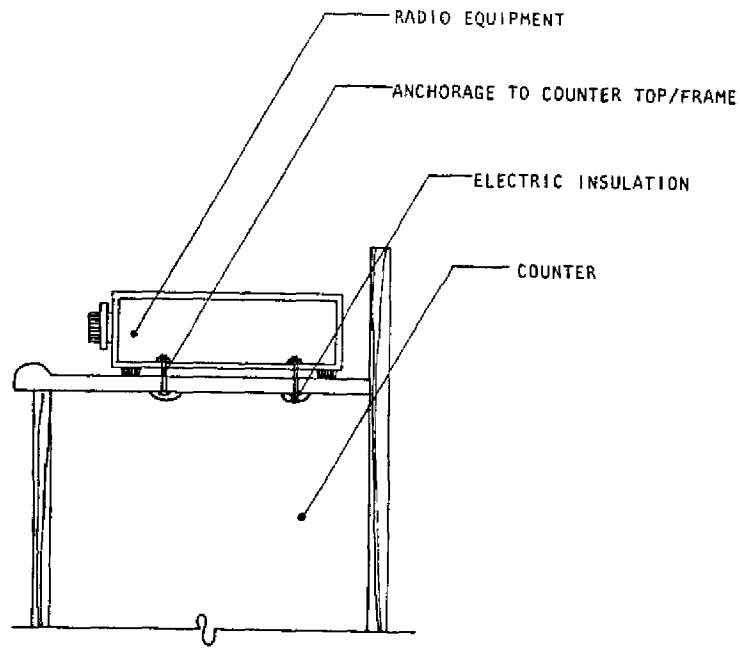


FIGURE 4.21. Communication systems Permanent two-way radio equipment installation

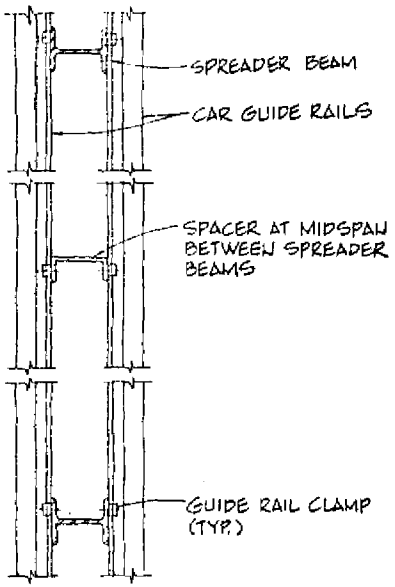
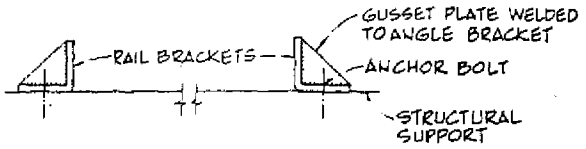


FIGURE 4.22. Elevator systems. Spacer between back-to-back car guide rails proposed by Ayres and Sun (1973).



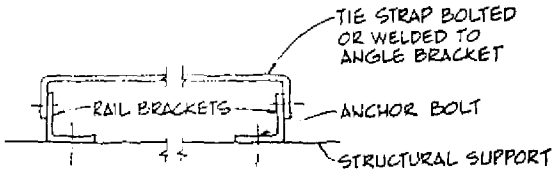


FIGURE 4.23. Elevator systems. Counterweight brackets proposed by Ayres and Sun (1973)

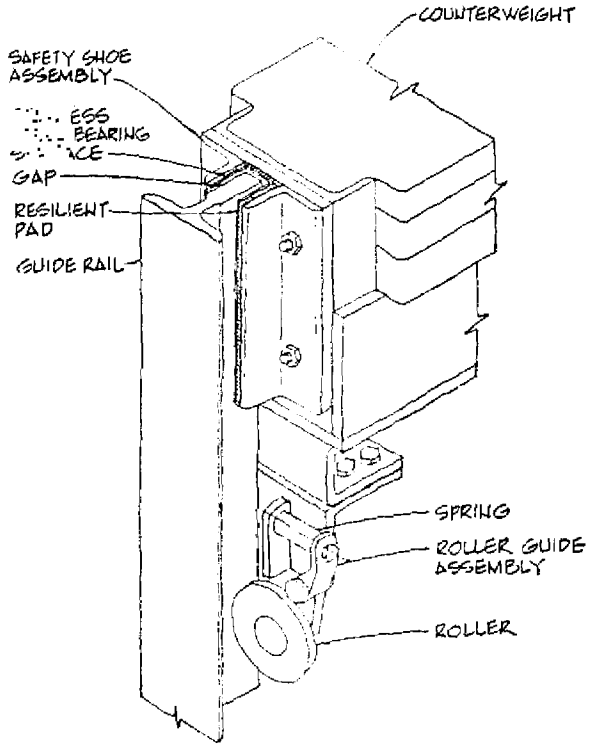


FIGURE 4.24. Elevator systems. Counterweight safety shoe proposed by Ayres and Sun (1973).

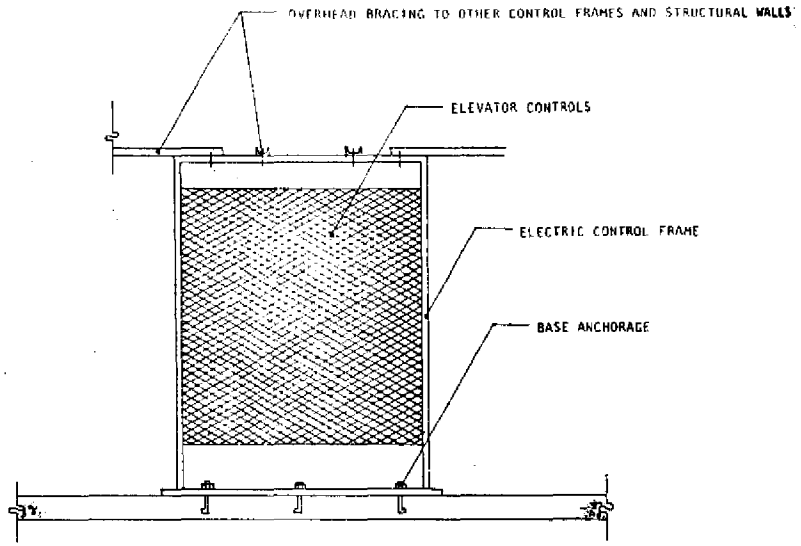


FIGURE 4.25. Elevator systems. Electric control panel showing base and top anchorage.

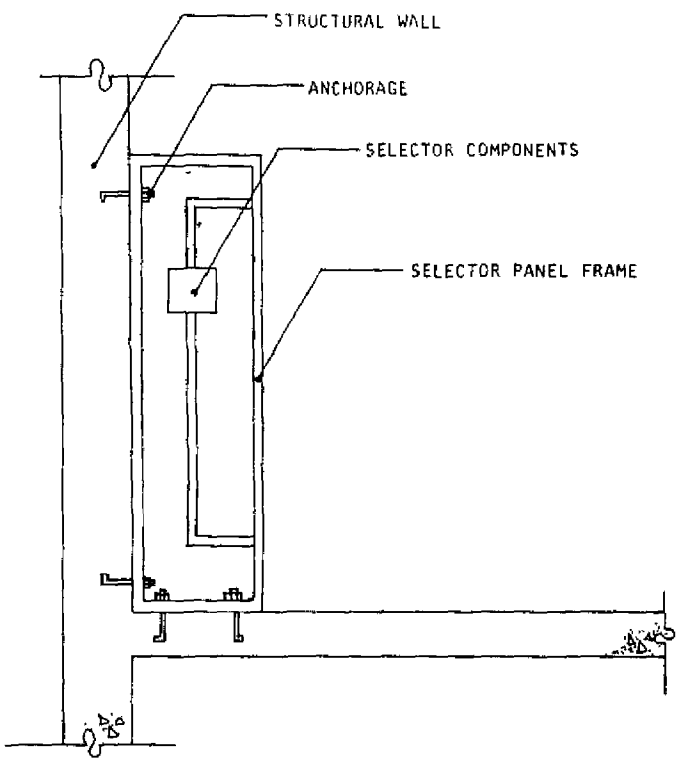


FIGURE 4.26. Elevator systems Installation of elevator selector panel

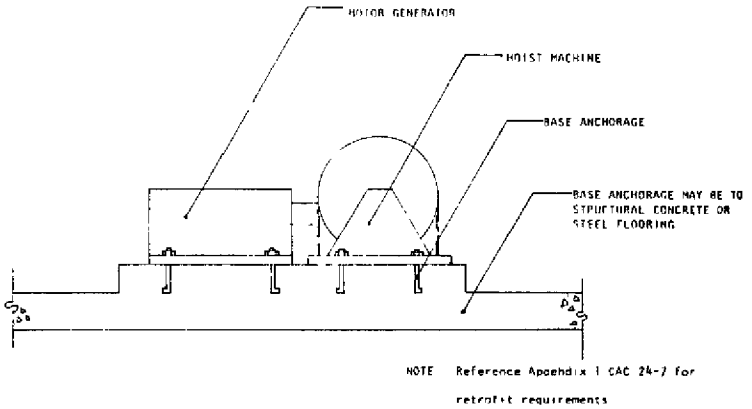


FIGURE 4.27. Elevator systems. Installation of geared and gearless hoist machines

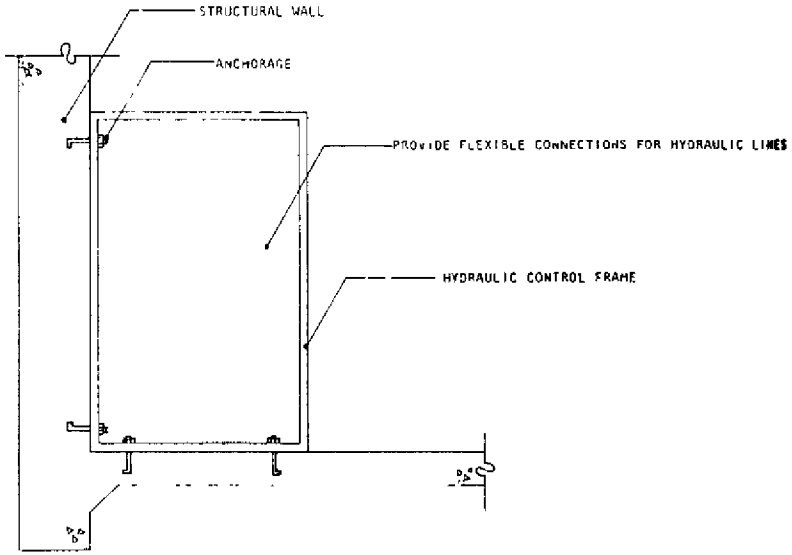


FIGURE 4.28. Elevator systems. Hydraulic controls

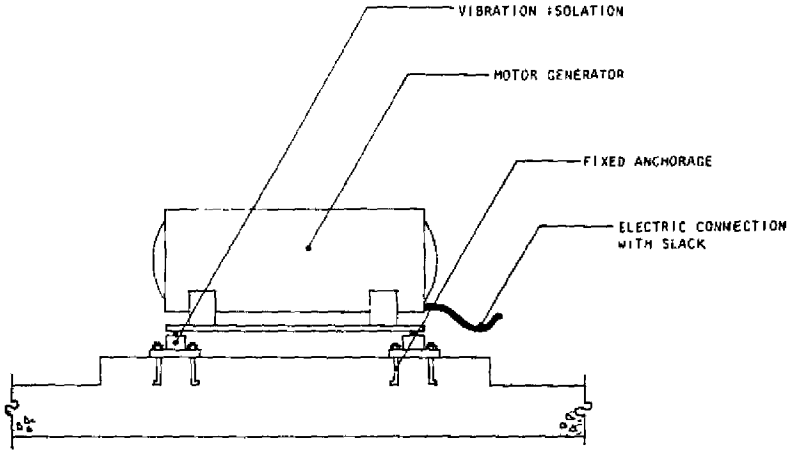


FIGURE 4.29. Elevator systems. Anchorage of motor generators.

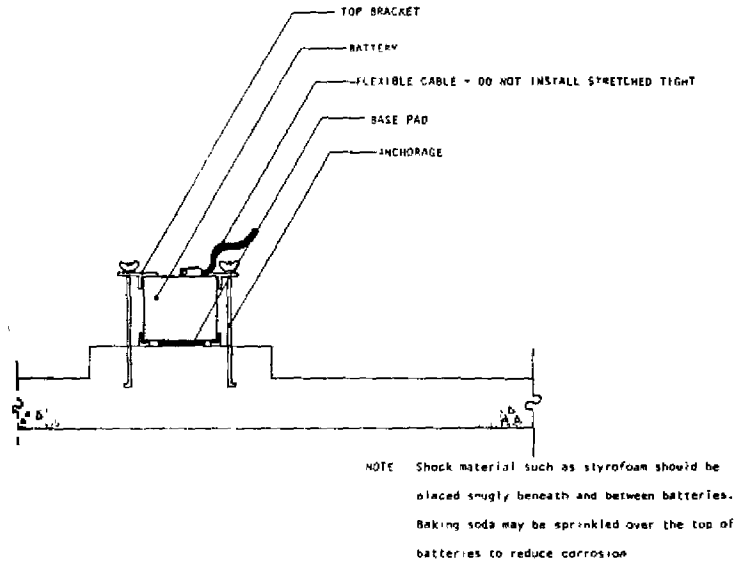


FIGURE 4.30. Emergency power supply systems. Emergency power supply battery set.

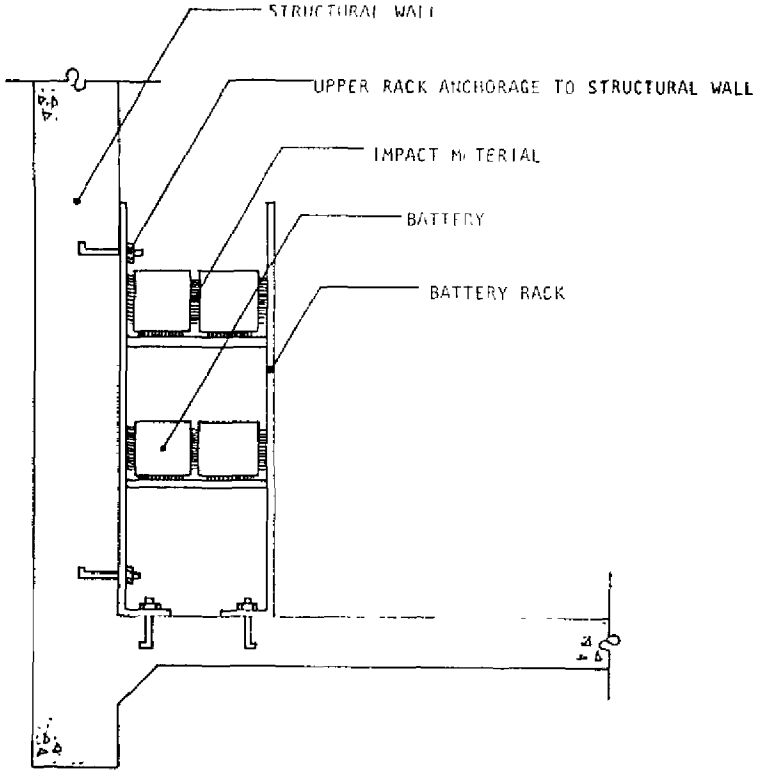


FIGURE 4.31. Emergency power supply systems Emergency power supply battery set

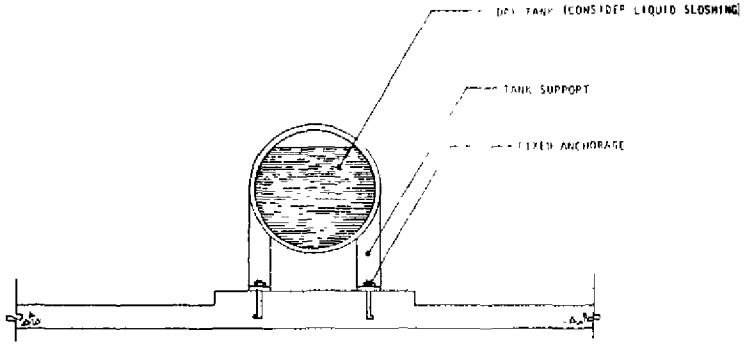


FIGURE 4.32 Emergency power supply systems Day tank—fixed installation

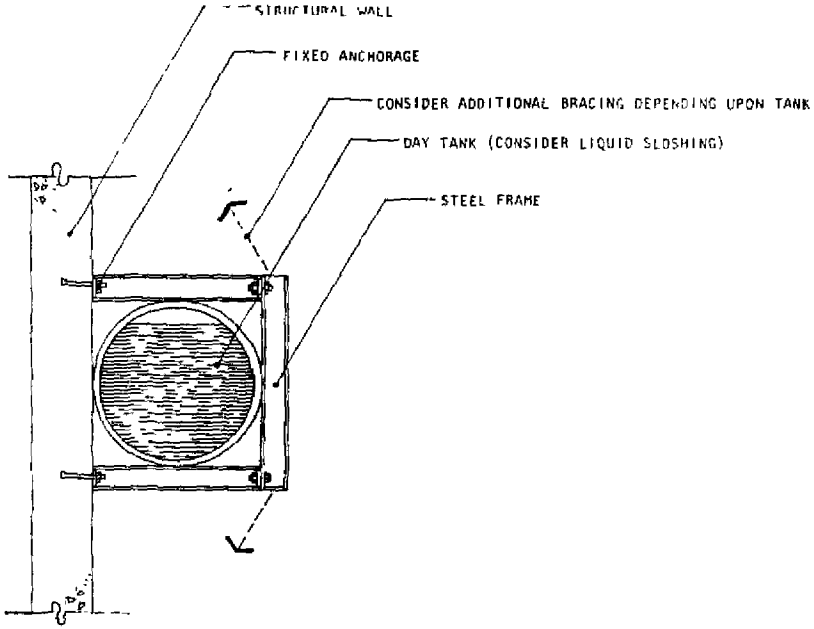


FIGURE 4.33. Emergency power supply systems Day tank—supported by a structural wall.

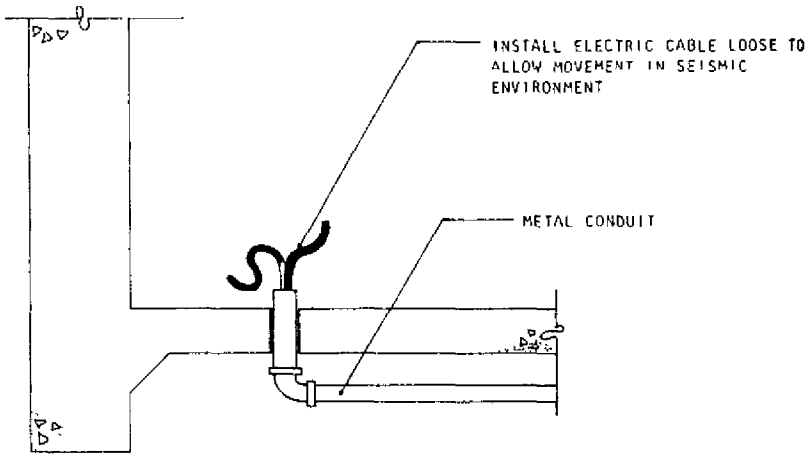


FIGURE 4.34. Emergency power supply systems. Electric cable installation.

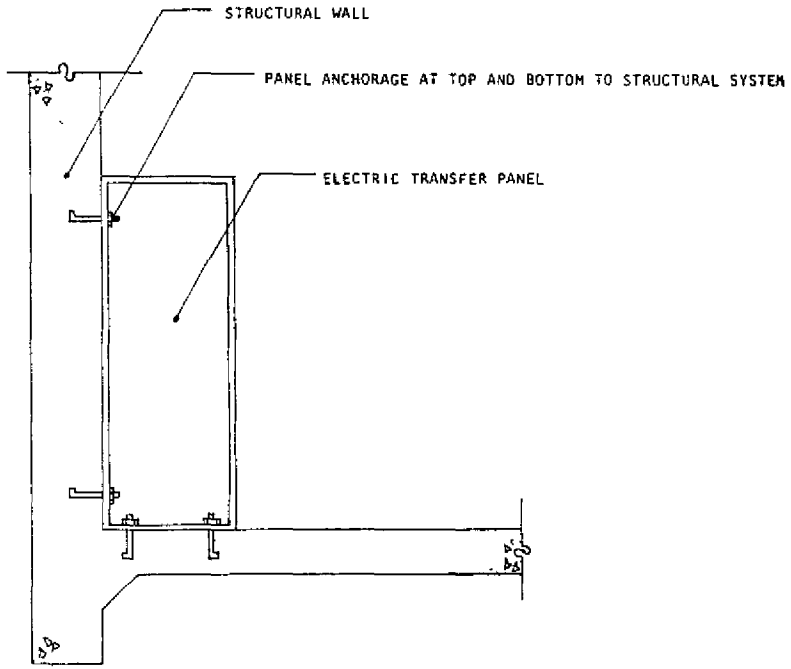


FIGURE 4.35. Emergency power supply systems. Electric transfer panels showing frame anchorage

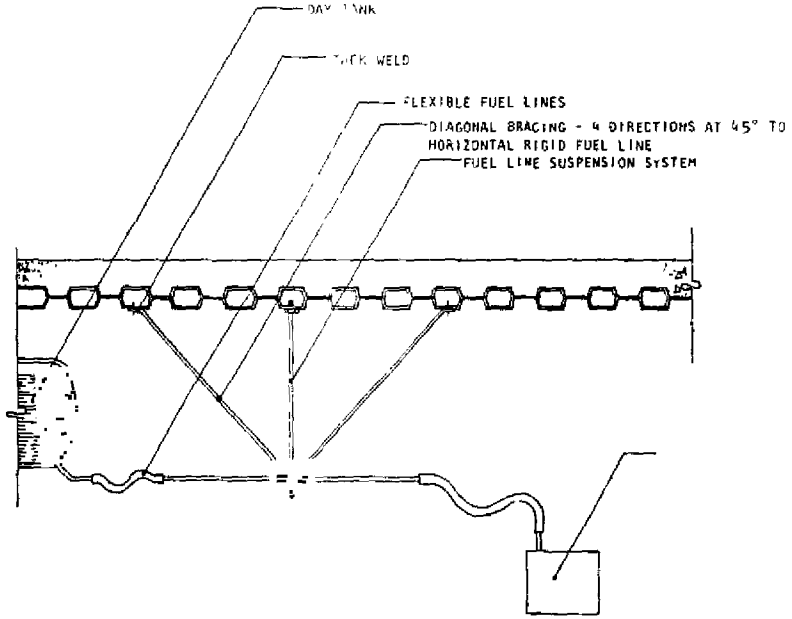


FIGURE 4.36. Emergency power supply systems Fuel line with flexible connections.

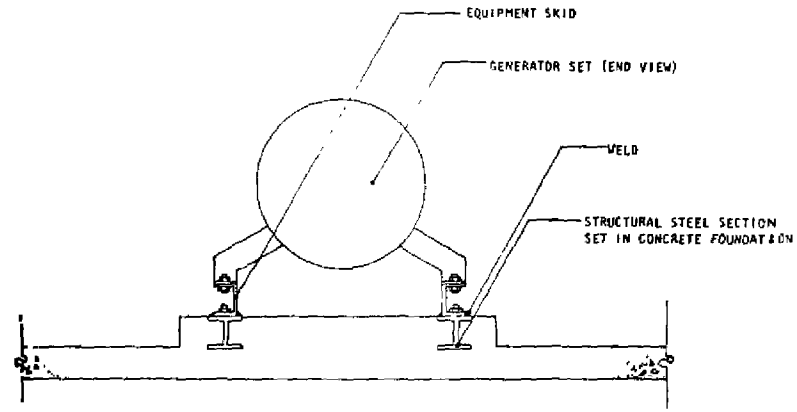


FIGURE 4.37. Emergency power supply systems. Generator set showing fixed anchorage to structural concrete.

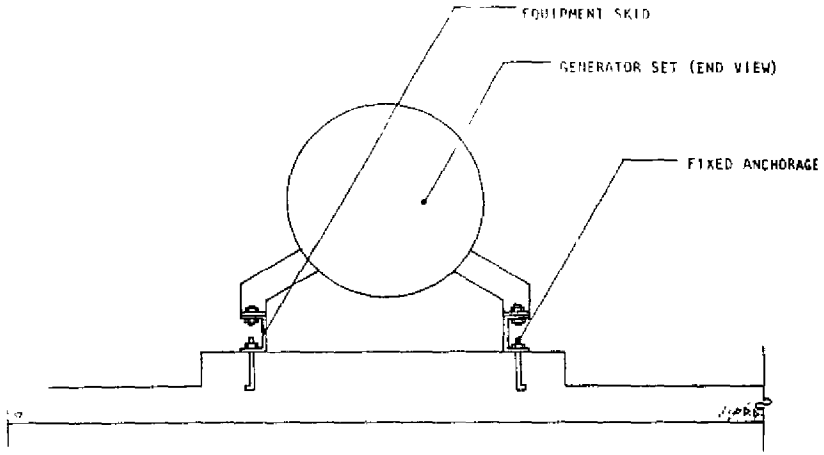


FIGURE 4.38. Emergency power supply systems. Generator set showing fixed anchorage to structural concrete.

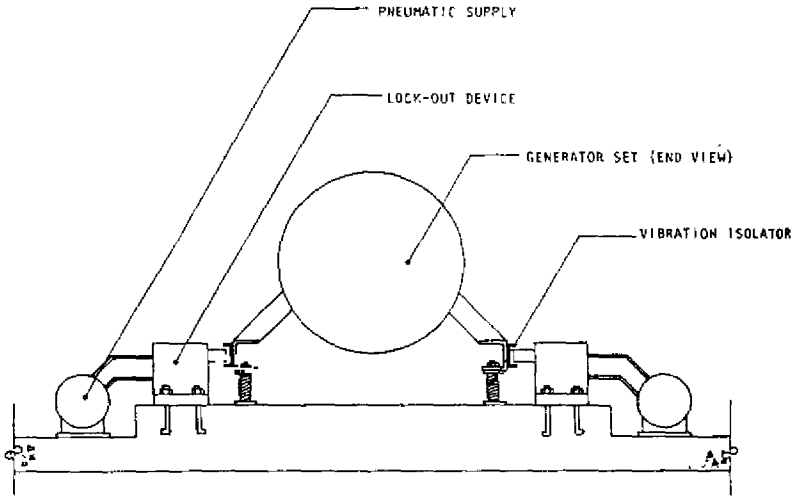


FIGURE 4.39. Emergency power supply systems Generator set—vibration isolation with lock-out device (refer to Consolidated Kinetics Corp. Appendix 3 Table A.2.4).

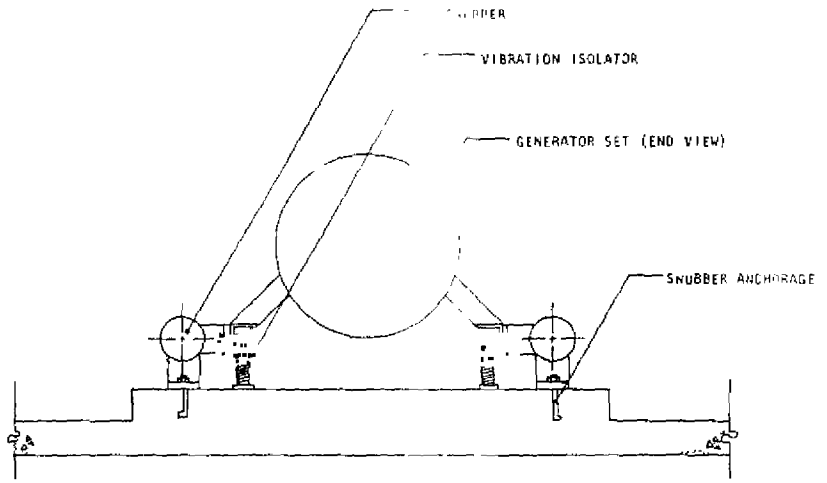


FIGURE 4.40. Emergency power supply systems Generator set—vibration isolation with motion restraints (refer to Mason Industries Appendix 2, Table A.2.4)

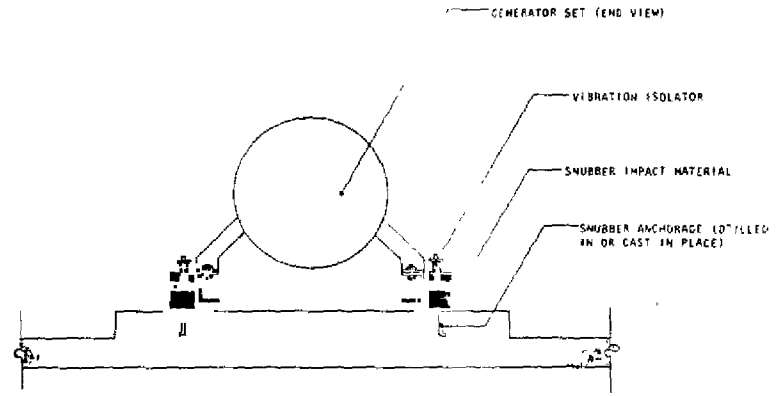


FIGURE 4.41. Emergency power supply systems. Generator set—vibration isolation with motion restraints (refer to California Dynamics Corporation Appendix 2 Table A.2.4).

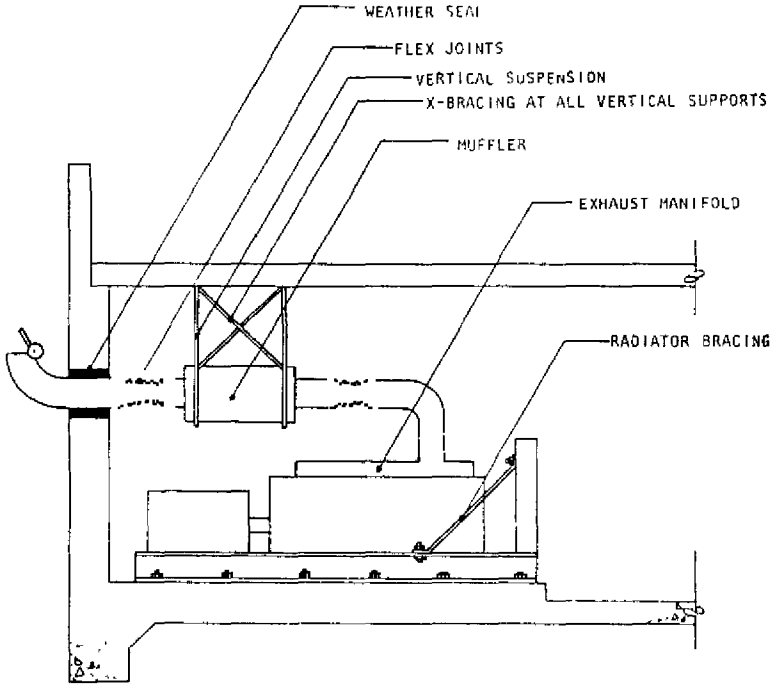


FIGURE 4.42. Emergency power supply systems. Muffler installation showing flexible connections, cross bracing, and bracing to radiator

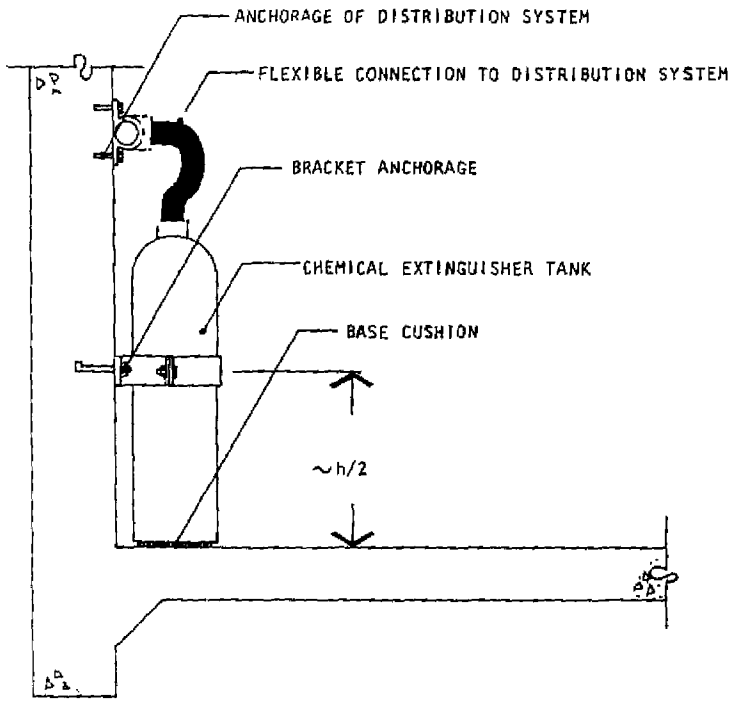


FIGURE 4.43. Fire protection systems Automatic chemical extinguishing system.

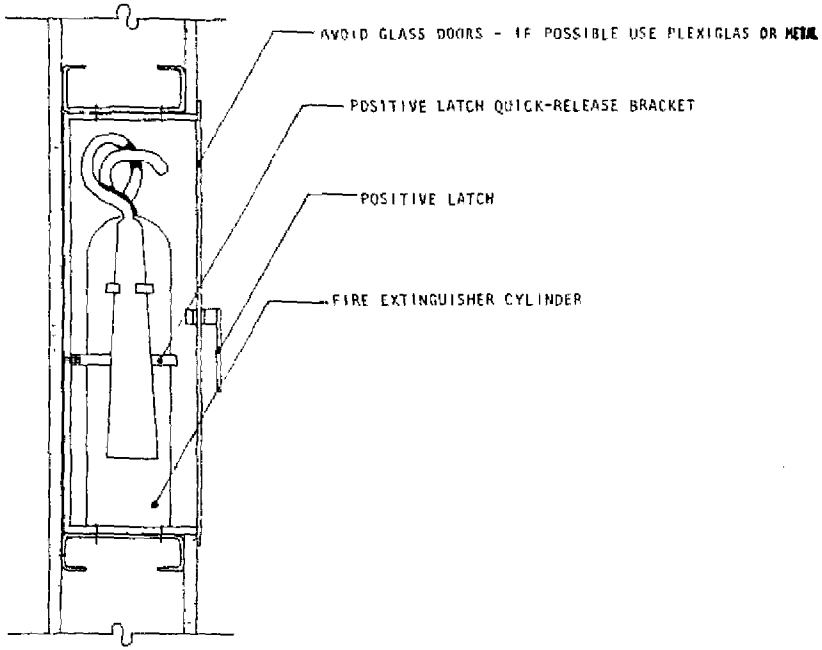


FIGURE 4.44. Fire protection systems. Fire extinguisher installed in a wall cabinet.

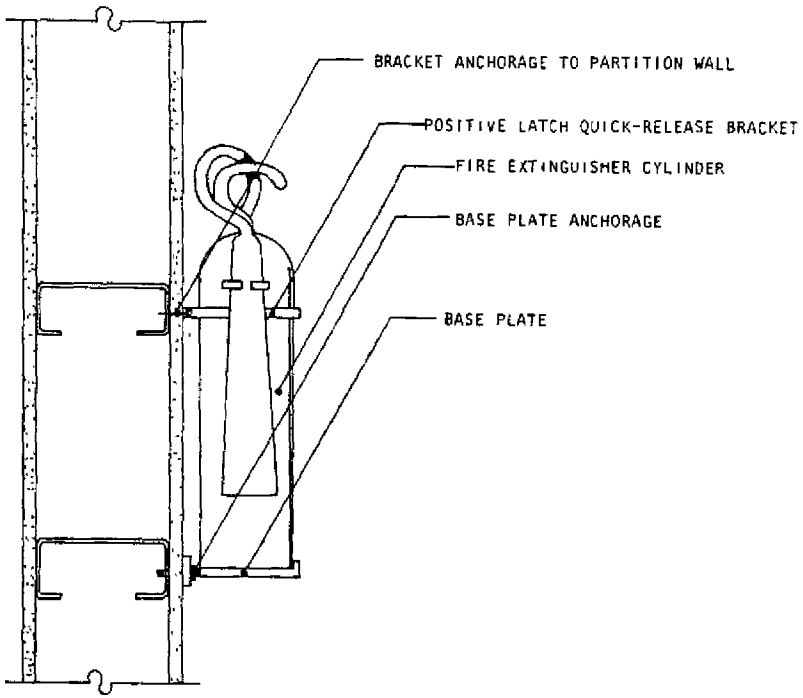


FIGURE 4.45. Fire protection systems Wall-hung fire extinguisher.

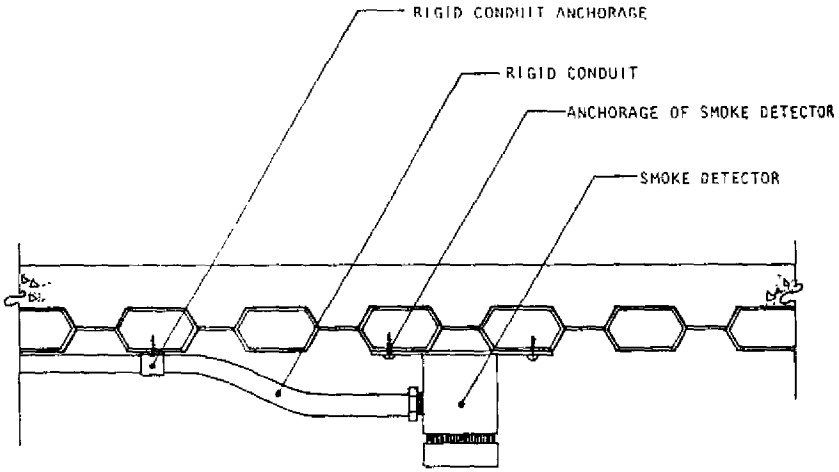


FIGURE 4.46 Fire protection systems. Smoke detector installation

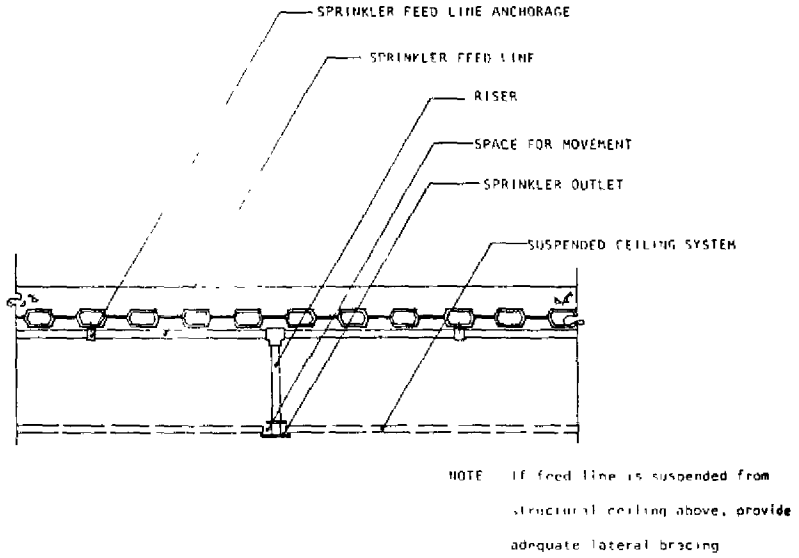


FIGURE 4.47. Fire protection systems. Sprinkler system.

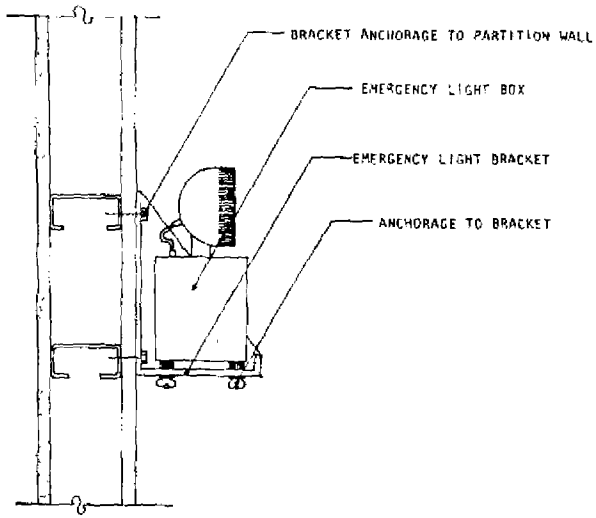


FIGURE 4.48. Lighting Systems. Wall-mounted emergency light.

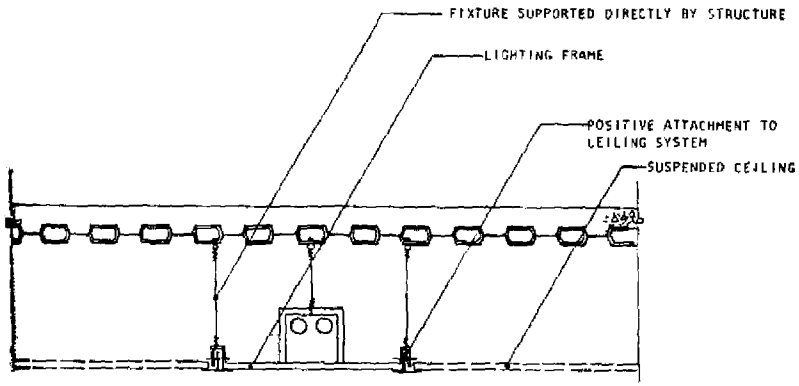


FIGURE 4.49. Lighting systems. Suspended ceiling lighting fixture.

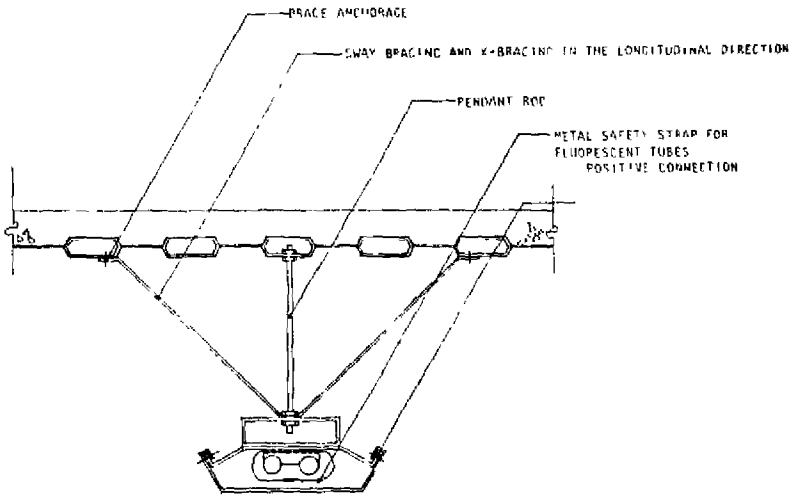


FIGURE 4.50. Lighting systems Pendant lights

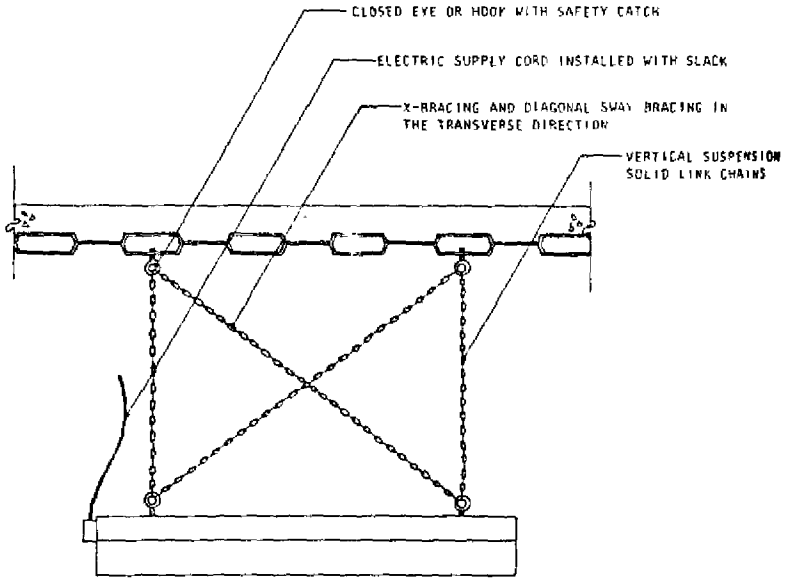


FIGURE 4.51. Lighting systems. Suspended fluorescent lighting

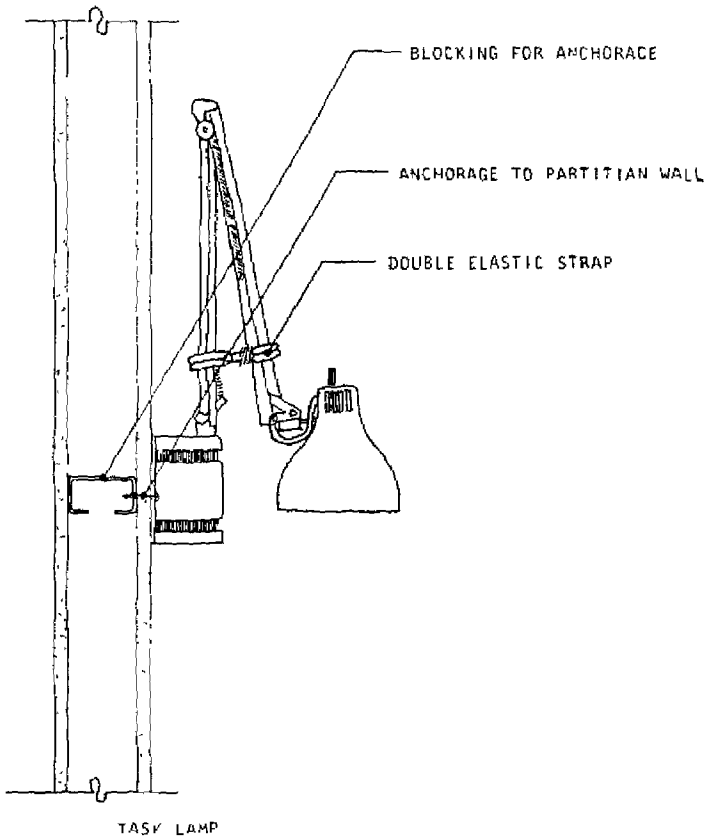


FIGURE 4.52. Lighting systems Task lamp Adapted from Stone, Marraccini, and Patterson, 1976.

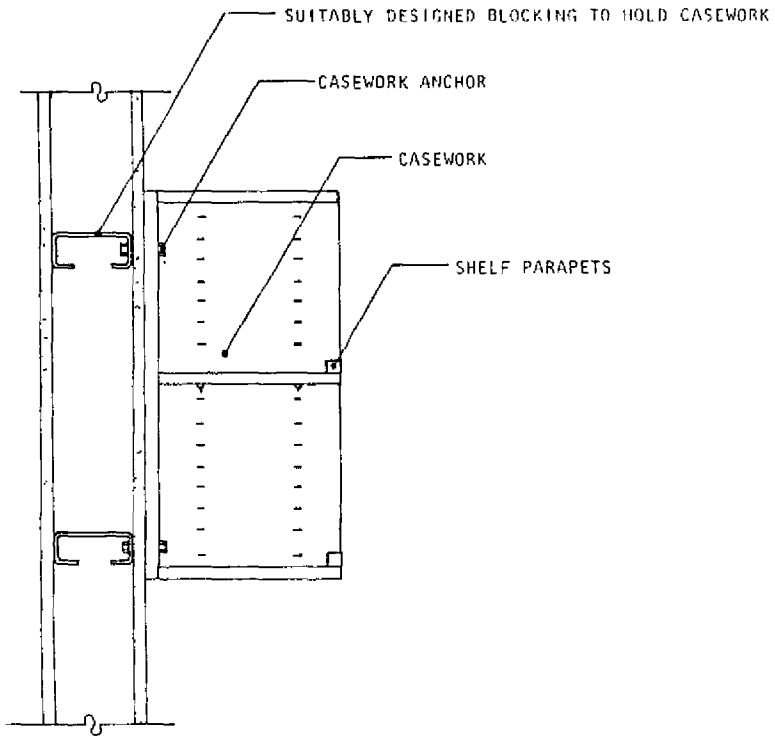


FIGURE 4.53. Medical systems. Casework with shelf parapets

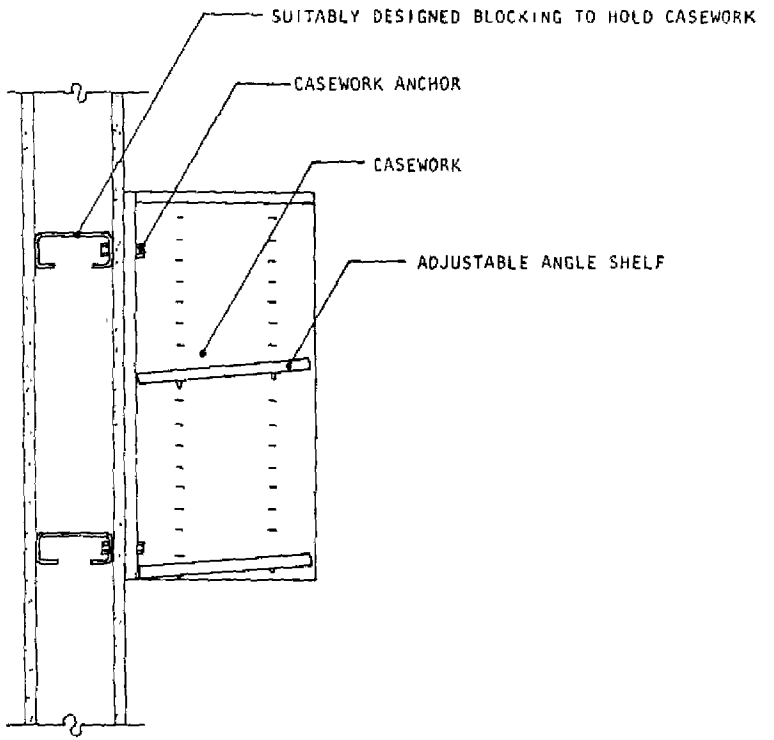


FIGURE 4.54. Medical systems. Casework with tilted shelves.

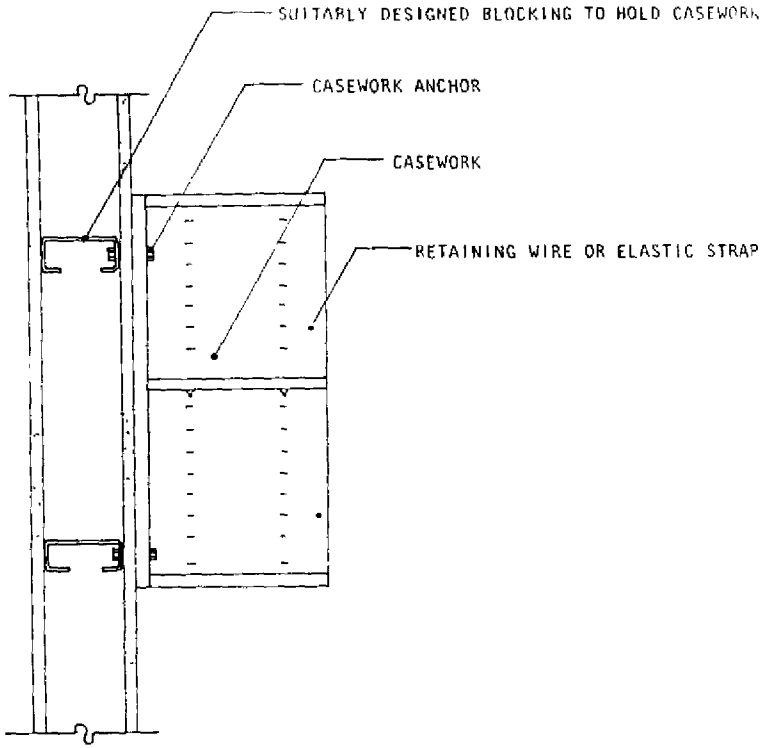


FIGURE 4.55. Medical systems Casework with elastic straps.

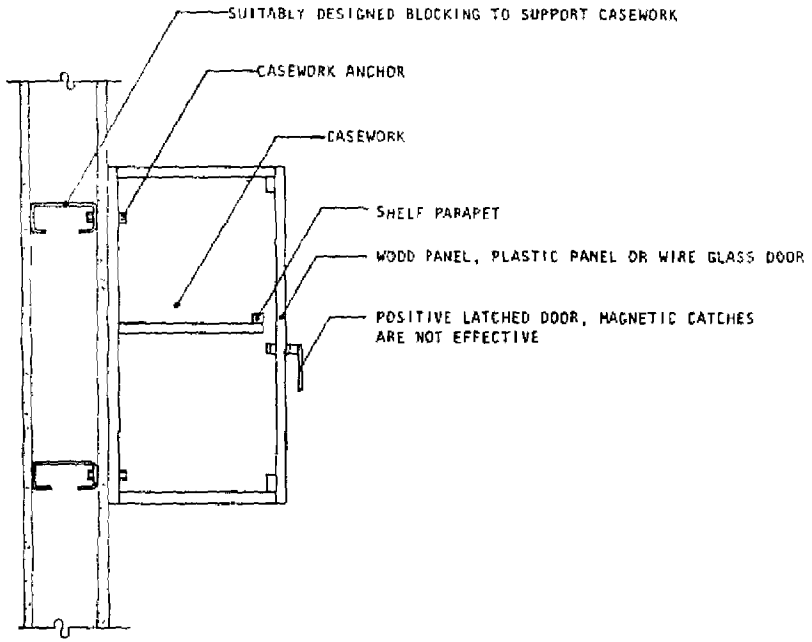


FIGURE 4.56. Medical systems. Casework with positive latched door.

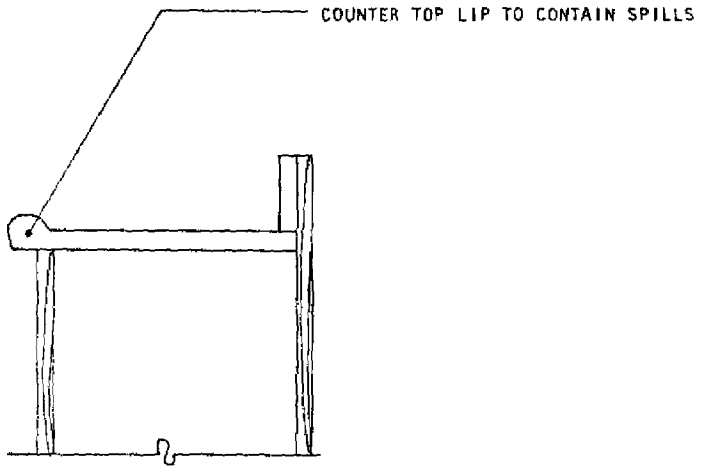


FIGURE 4.57. Medical systems Counter top with lip.

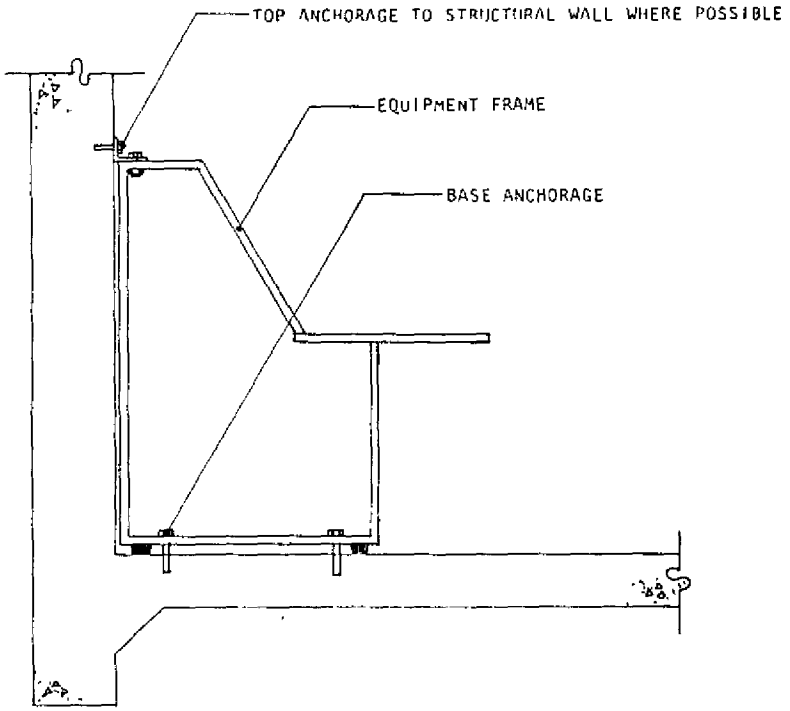


FIGURE 4.58. Medical systems. Frame type equipment.

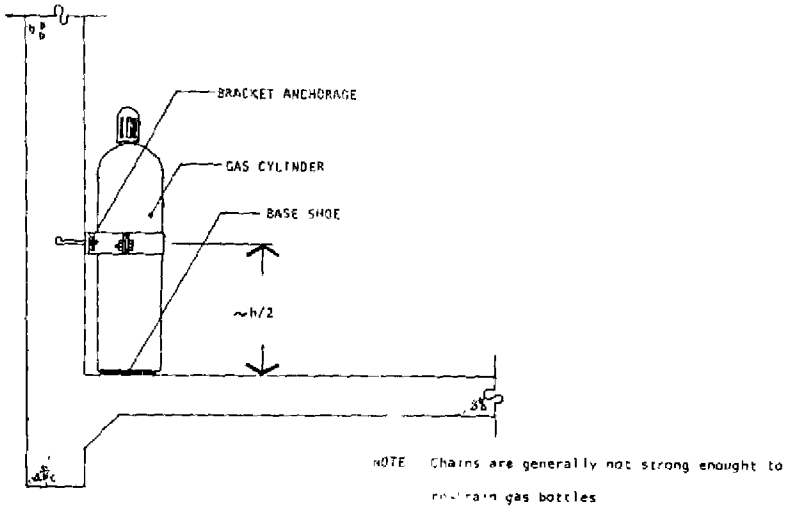


FIGURE 4.59. Medical systems Gas cylinder anchorage.

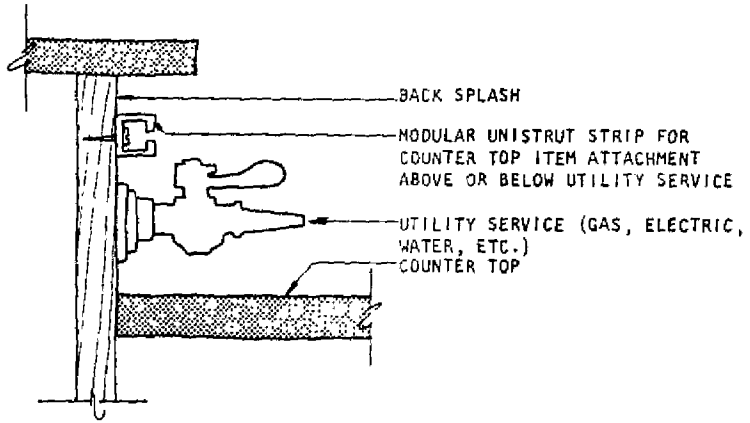


FIGURE 4.60. Medical systems. Counter top attachment rail for miscellaneous lab equipment. Adapted from Stone, Marraccini, and Patterson, 1976.

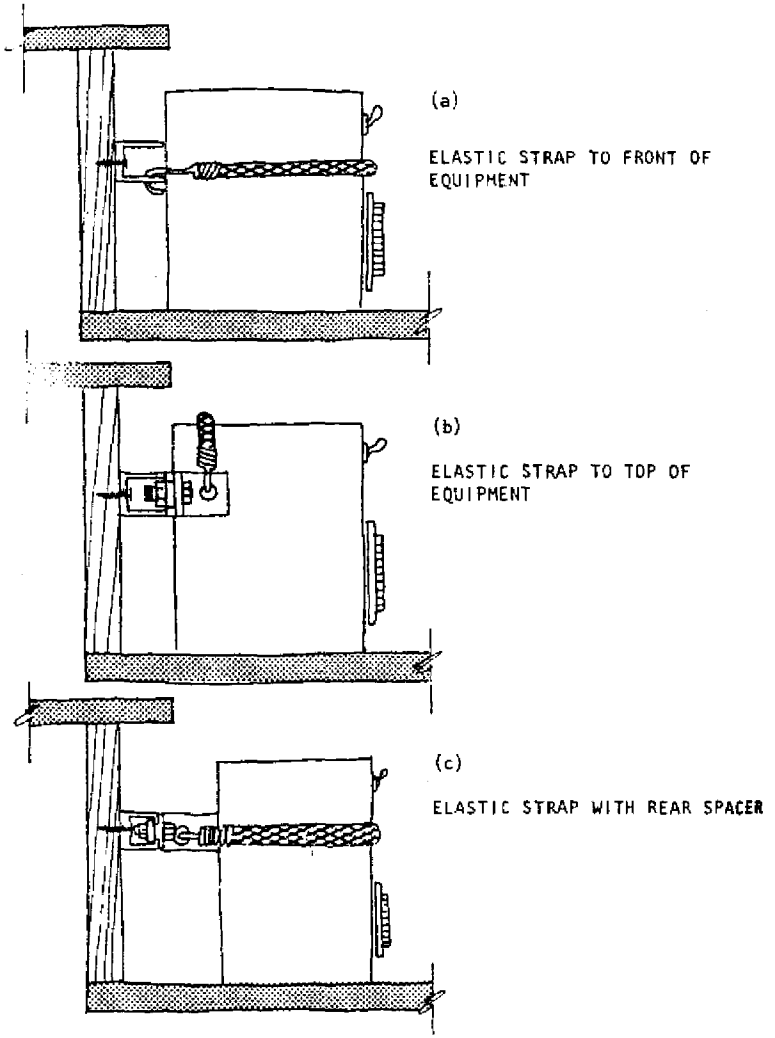


FIGURE 4.61. Medical systems. Counter top item attachment with elastic straps. Adapted from Stone, Marraccini, and Patterson, 1976.

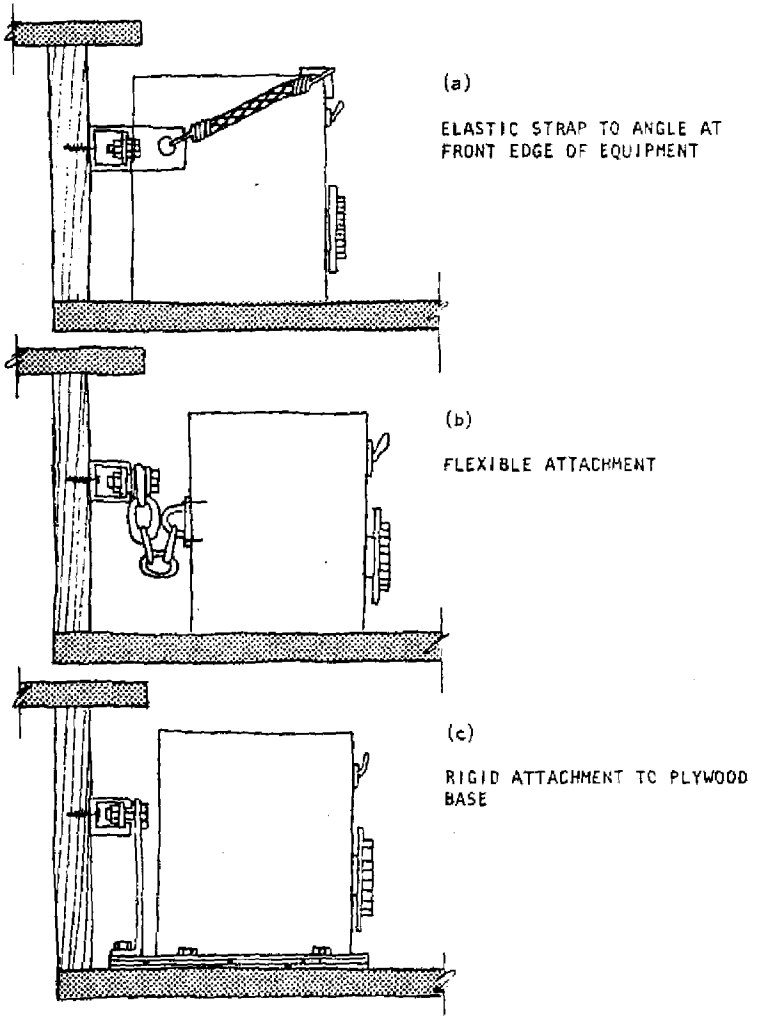


FIGURE 4.62. Medical systems. Counter top item attachment—flexible and fixed positioning. Adapted from Stone, Marraccini, and Patterson, 1976.

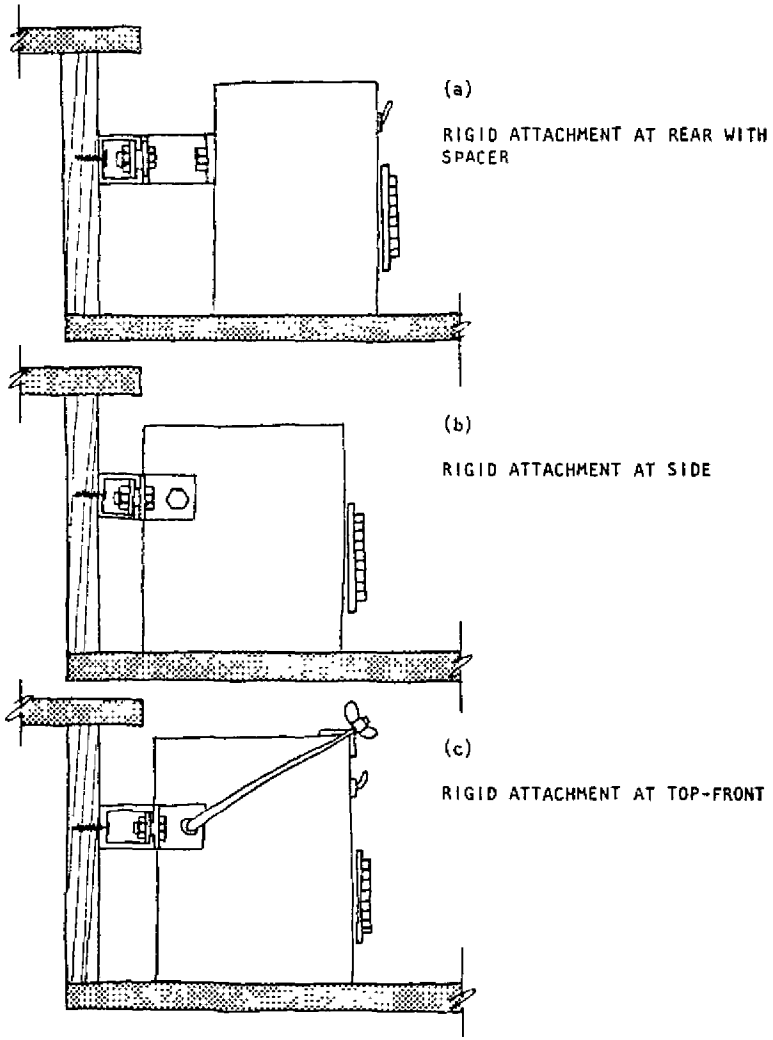


FIGURE 4.63. Medical systems. Rigid counter top equipment attachment. Adapted from Stone, Marraccini, and Patterson, 1976

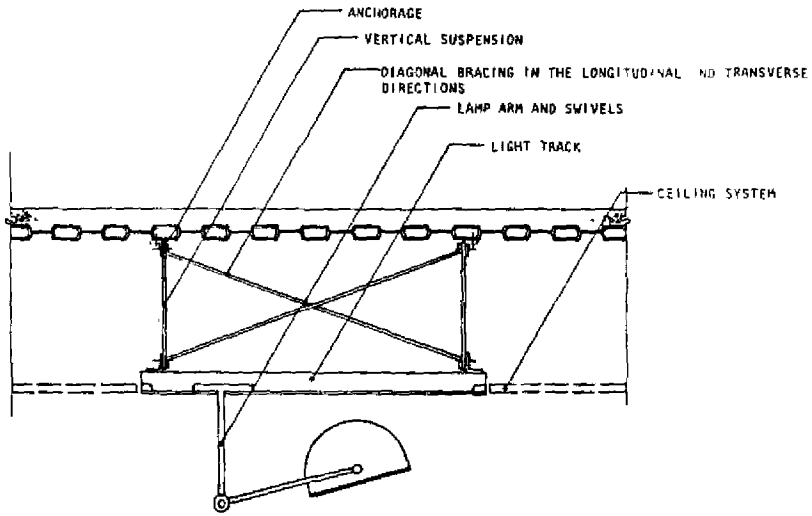


FIGURE 4.64. Medical systems. Operating room lighting.

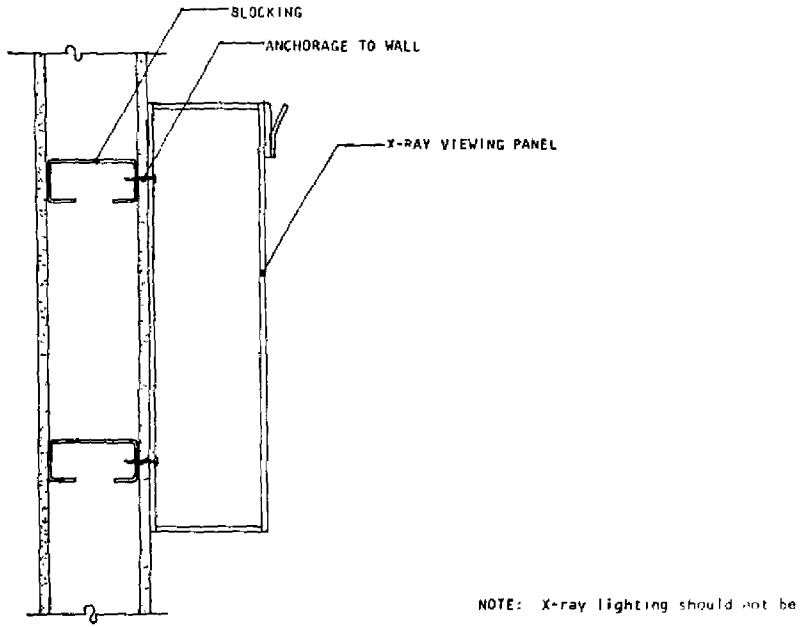


FIGURE 4.65. Medical systems. X-Ray lighting anchorage.

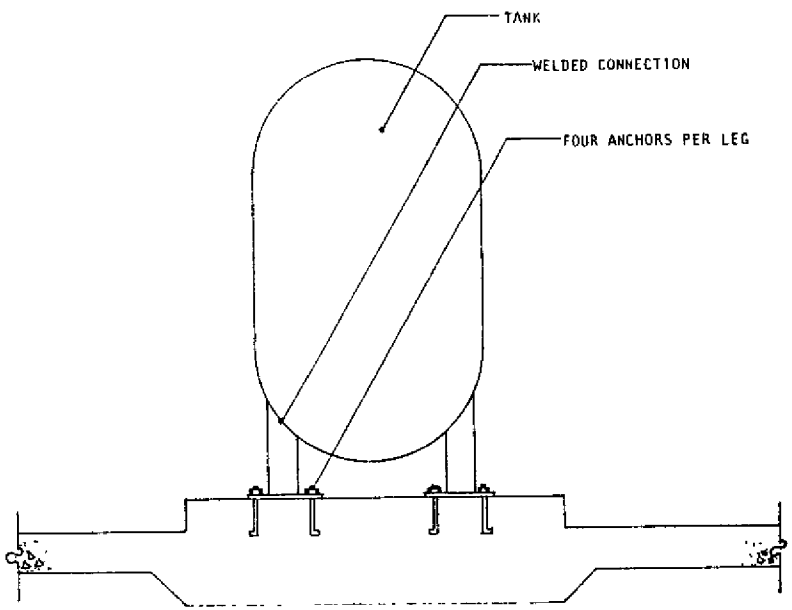


FIGURE 4.66. Medical systems. Liquid oxygen storage tank anchorage.

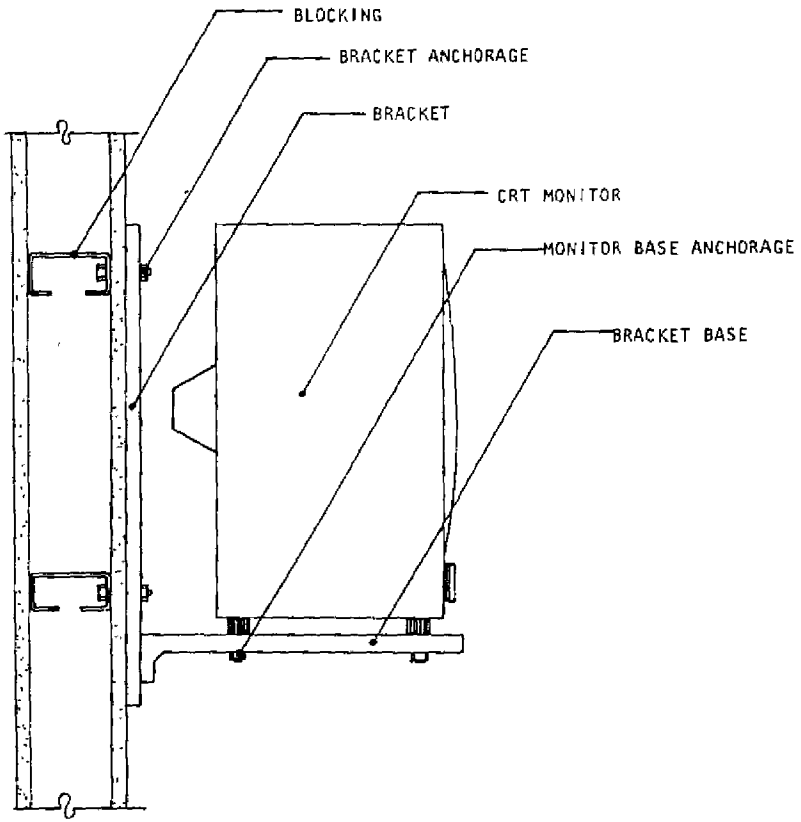


FIGURE 4.67. Medical systems CRT monitor installation.

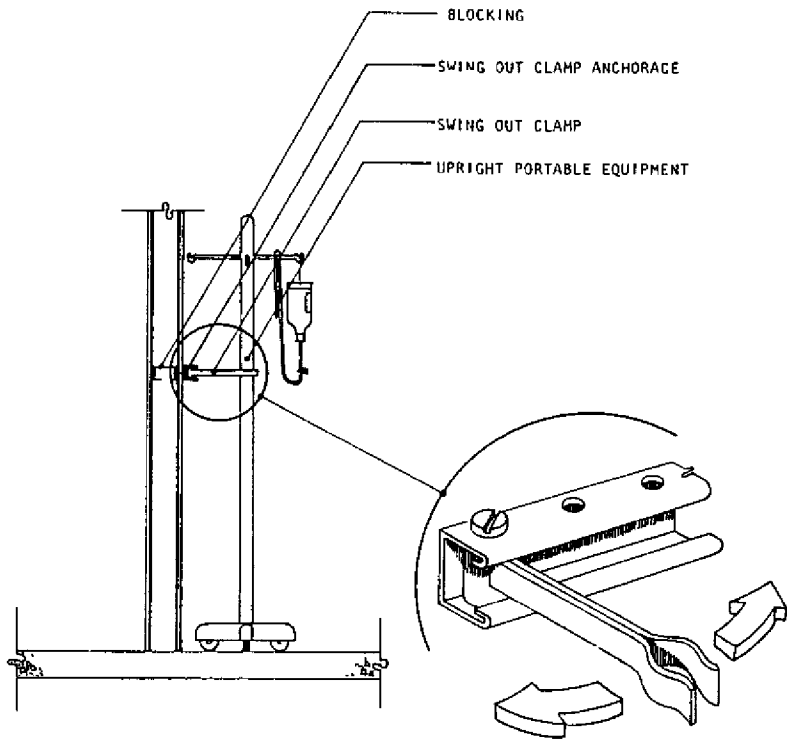


FIGURE 4.68. Medical systems. Upright portable equipment anchorage.

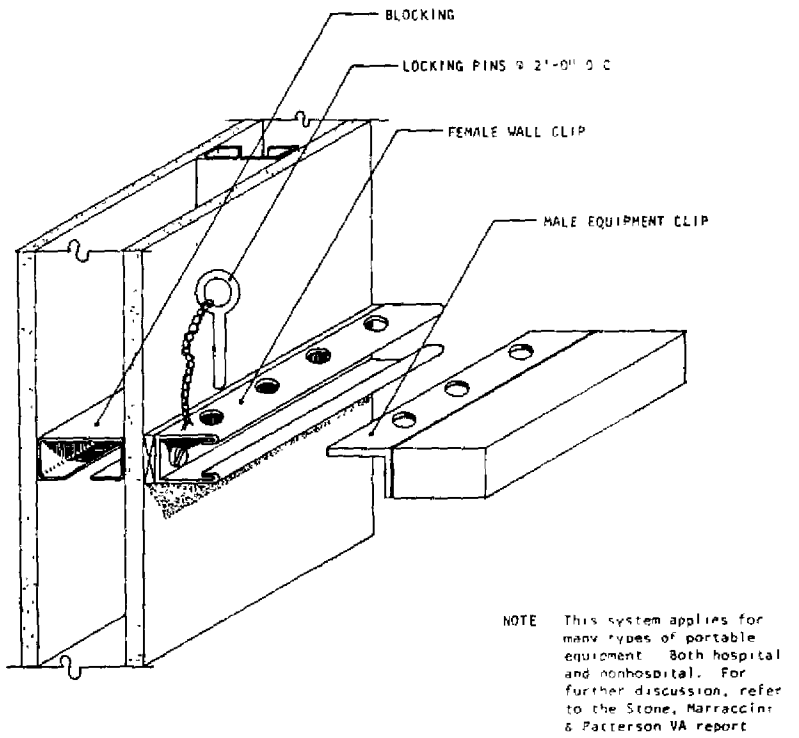


FIGURE 4.69. Medical systems. Portable equipment retainer. Adapted from Stone, Marraccini, and Patterson, 1976.

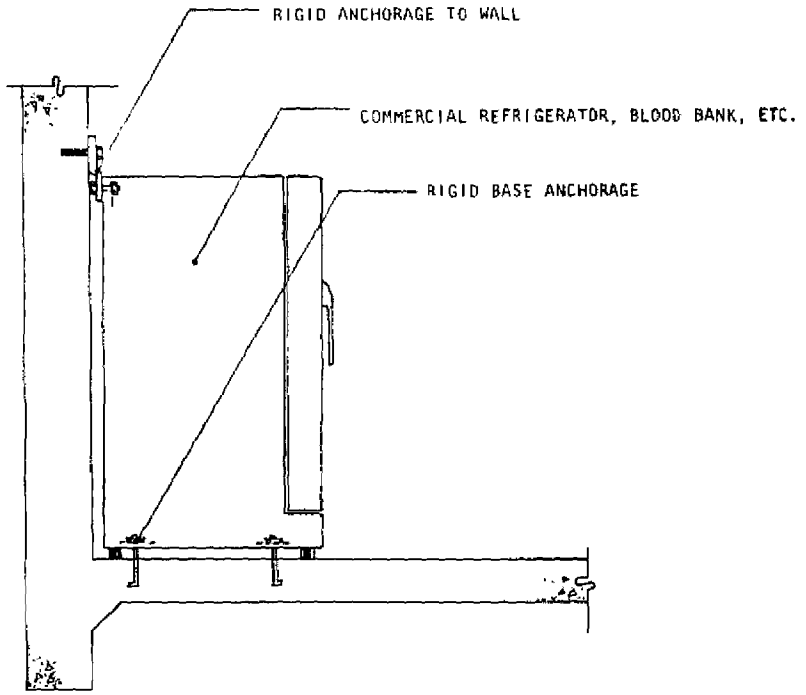


FIGURE 4.70. Medical systems. Installation of commercial refrigerator, blood bank, bone bank, and so on.

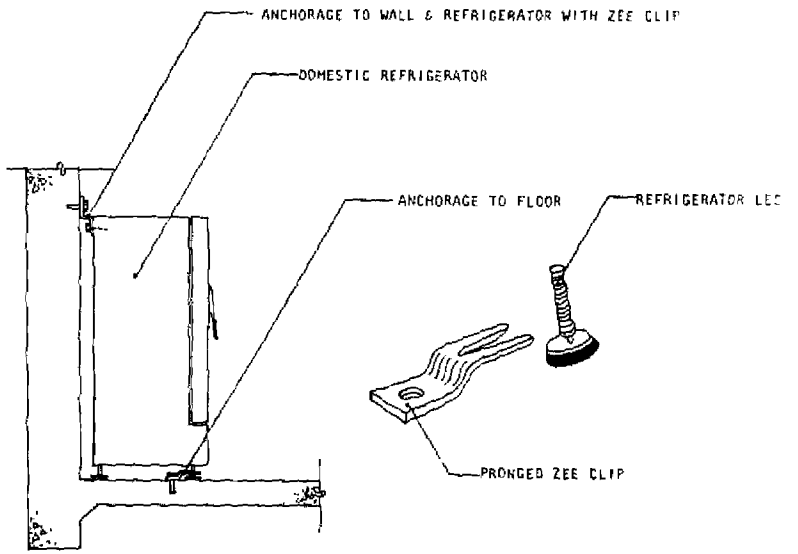


FIGURE 4.71. Medical systems. Domestic refrigerator installation. Adapted from Stone, Marraccini, and Patterson, 1976.

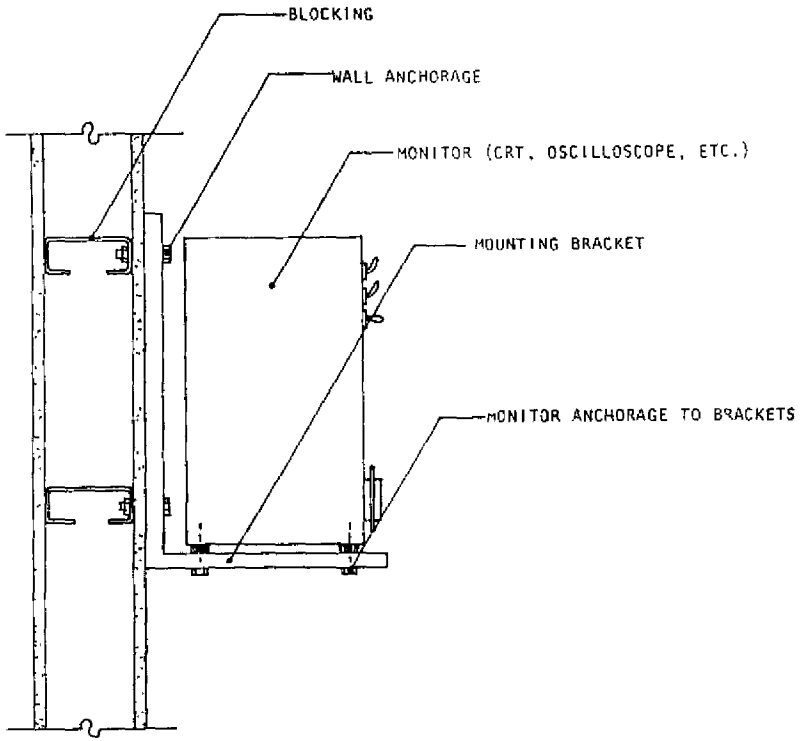


FIGURE 4.72. Medical systems. Monitor anchorage to wall-mounted shelf.

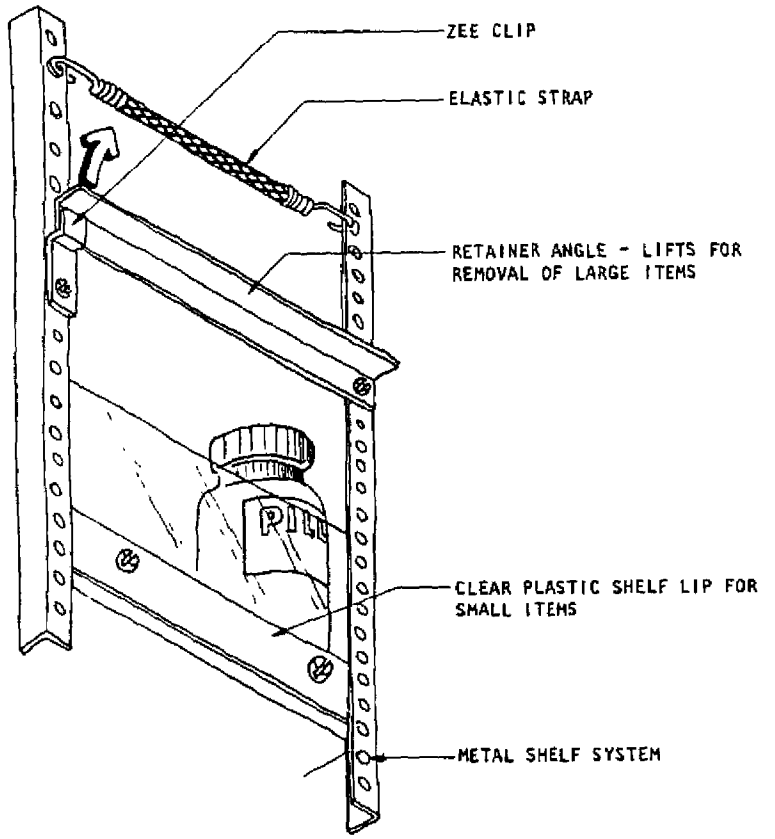


FIGURE 4.73. Medical systems. Typical shelved item retainers. Adapted from Stone, Marraccini and Patterson, 1976.

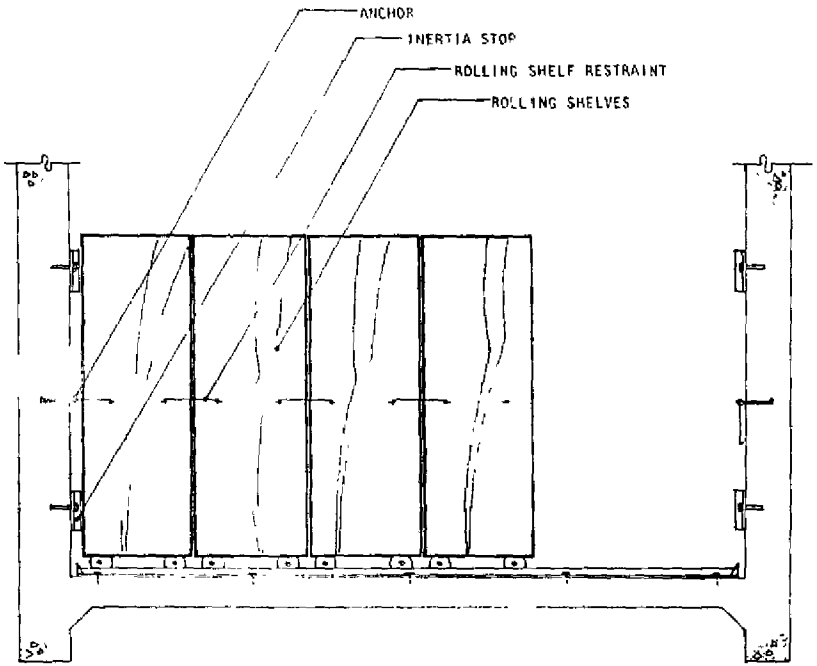


FIGURE 4.74. Medical systems Rolling shelving

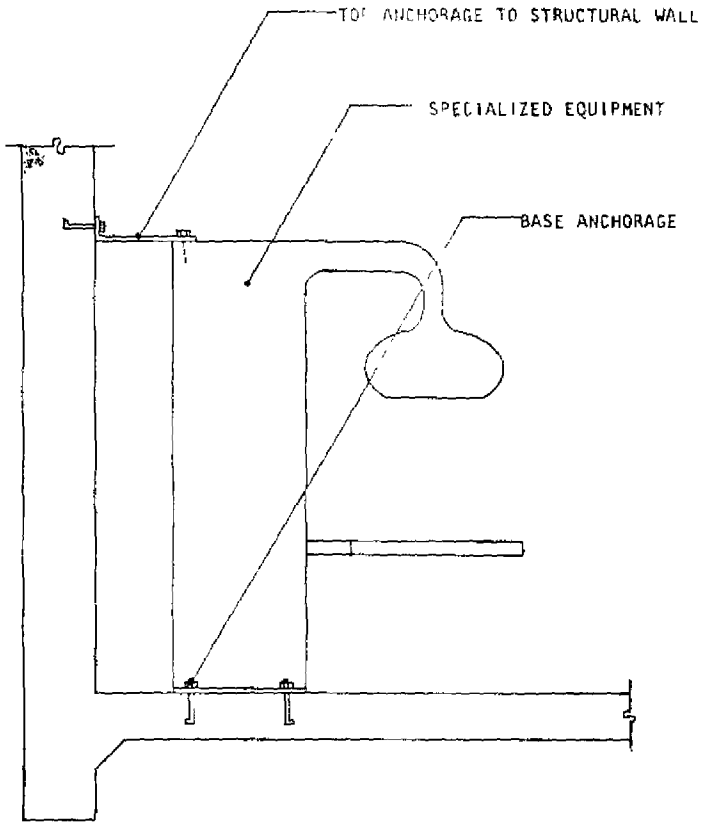


FIGURE 4.75. Medical systems Specialized equipment installation.

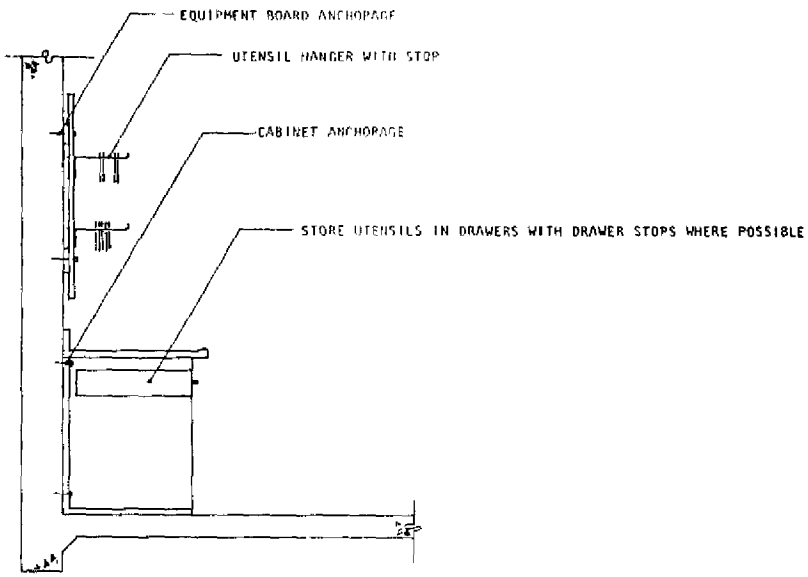


FIGURE 4.76. Medical systems. Storage of operating room utensils.

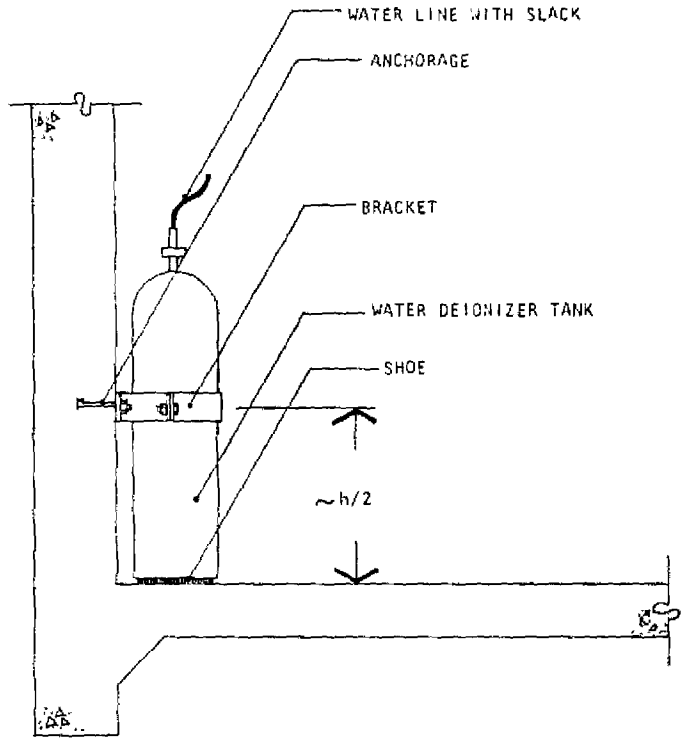


FIGURE 4.77. Medical systems. Storage of water deionizers for kidney dialysis.

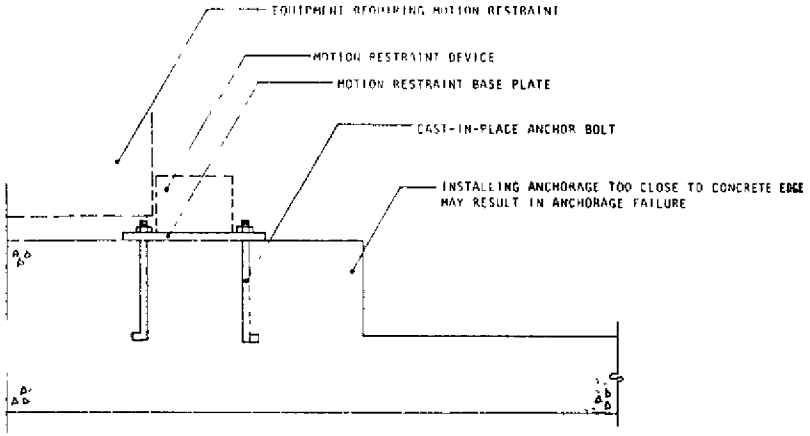


FIGURE 4.78. Motion restraint systems. Cast-in-place anchor bolts require greater accuracy of all trades associated with installation of this equipment

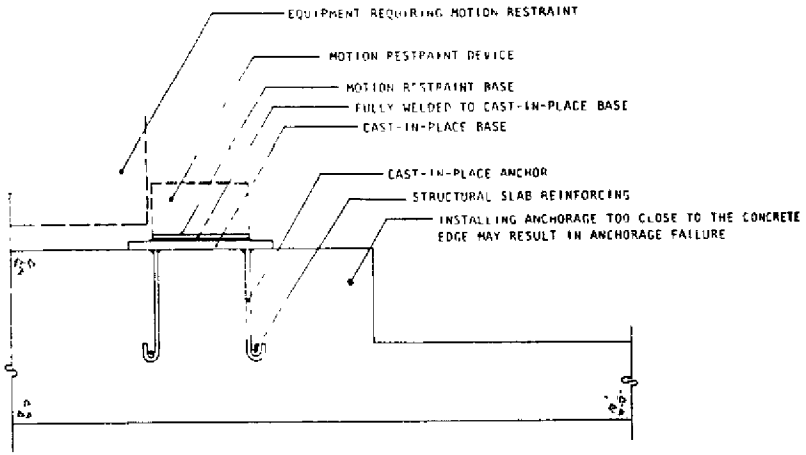


FIGURE 4.79. Motion restraint systems Cast-in-place base plate anchorage allows the equipment installer greater flexibility

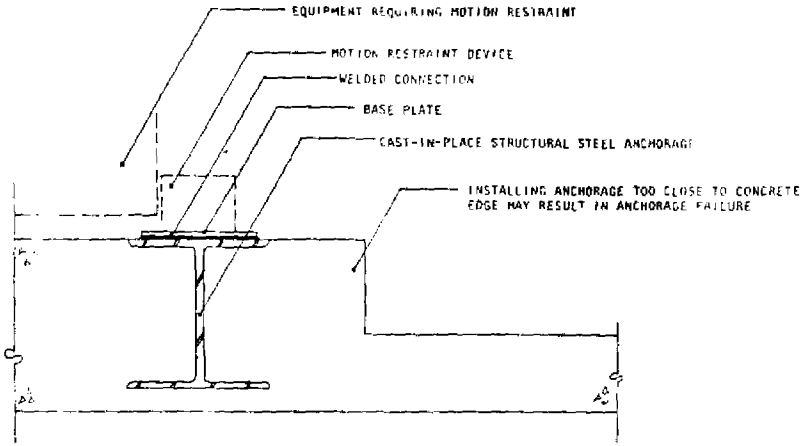


FIGURE 4.80. Motion restraint systems. Cast-in-place structural steel anchorage for motion restraint devices

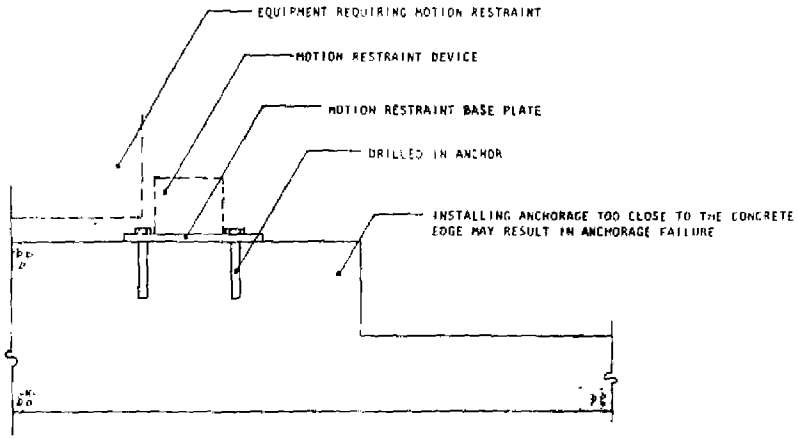


FIGURE 4.81. Motion restraint systems. Drilled in anchors allow the field trades ample latitude in equipment installation

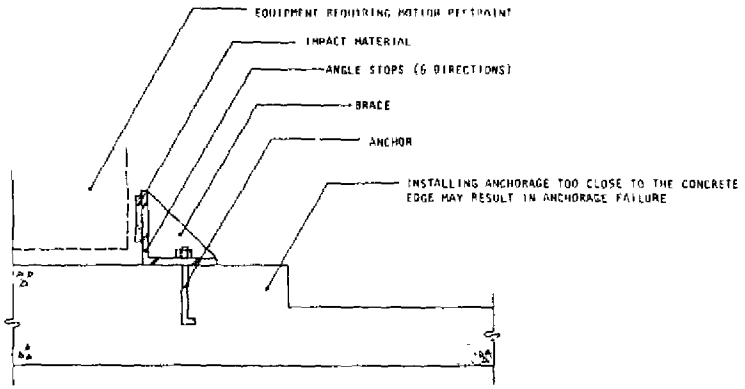


FIGURE 4.82. Motion restraint systems. Angle stops for lightweight, noncritical equipment.

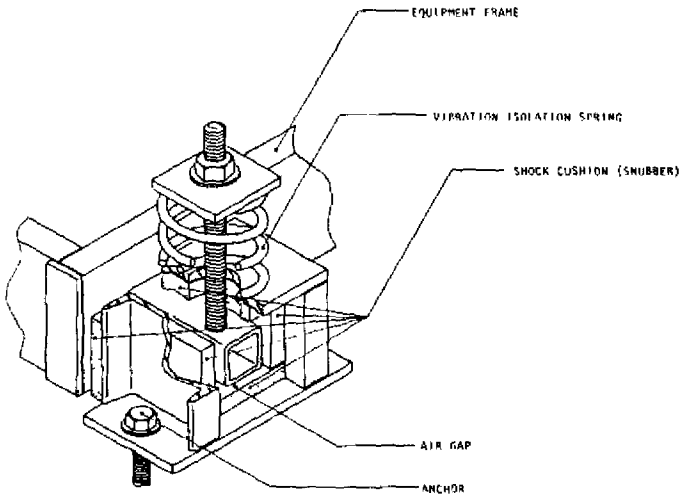


FIGURE 4.83. Motion restraint systems. Integral vibration isolation and snubbing device (California Dynamics Corporation type HQ, refer to Appendix 2, California Dynamics Corporation for installation applications and requirements.)

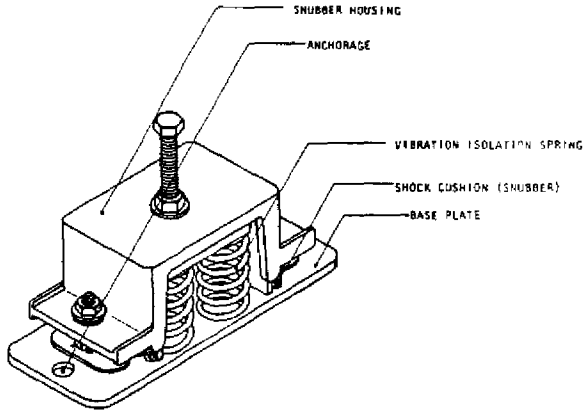


FIGURE 4.84. Motion restraint systems. Integral vibration isolation and snubbing device (California Dynamics Corporation Type RJ, refer to Appendix 2, California Dynamics Corporation for installation applications and requirements.)

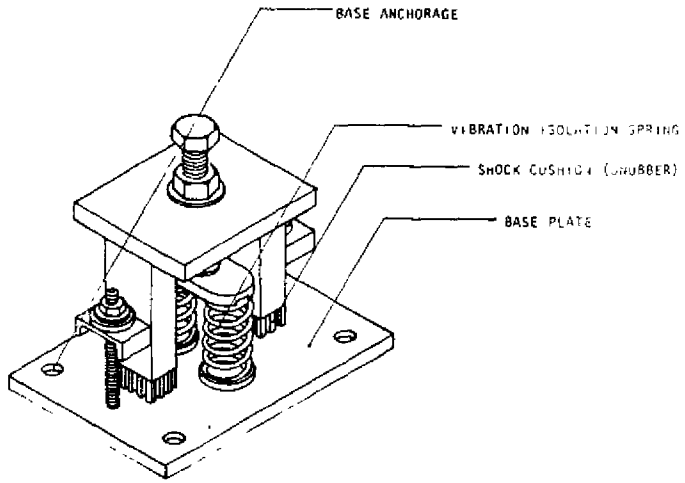


FIGURE 4.85. Motion restraint systems. Integral vibration isolation and snubbing device (California Dynamics Corporation type RJS, refer to Appendix 2, California Dynamics Corporation for installation applications and requirements.)

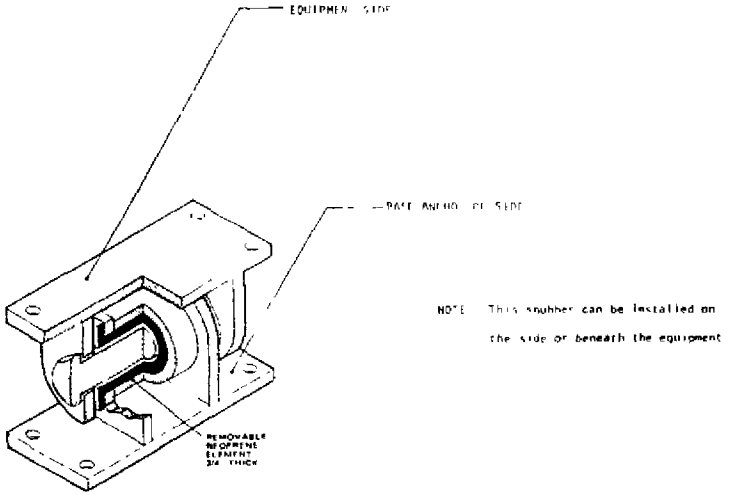


FIGURE 4.86. Motion restraint systems. Typical seismic all directional snubber. (Mason Industries type Z-1011; refer to Appendix 2, Mason Industries, Inc. for installation applications and requirements.)

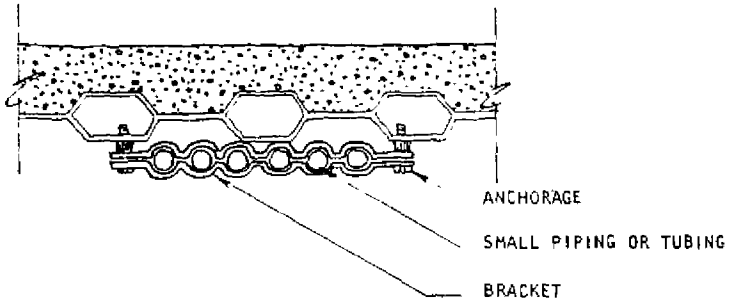


FIGURE 4.87. Piping systems. Bracing for small piping or tubing.

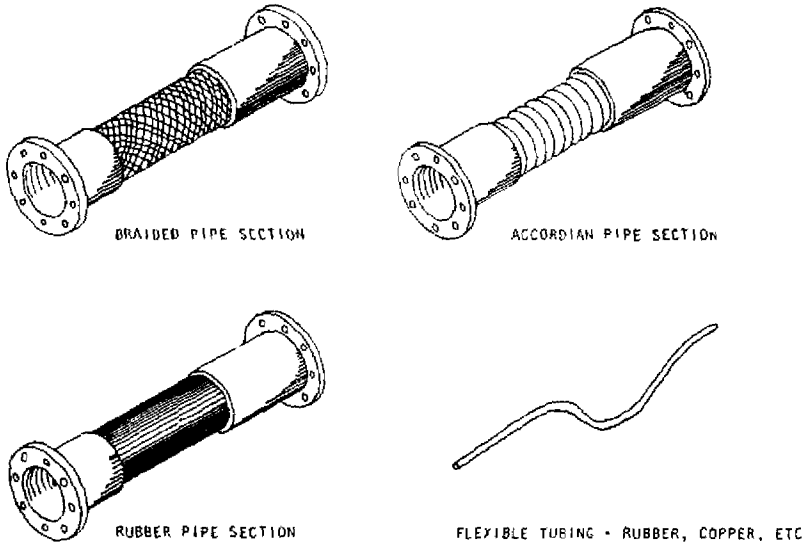


FIGURE 4.88. Piping systems. Flexible pipe and tubing connectors.

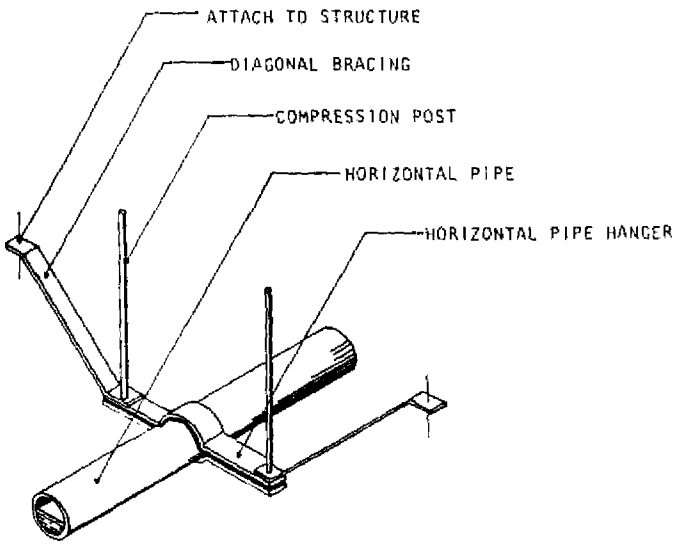
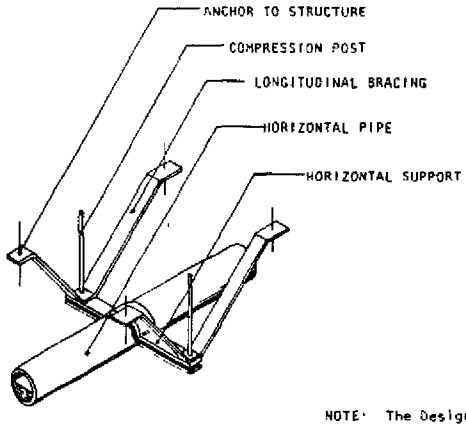
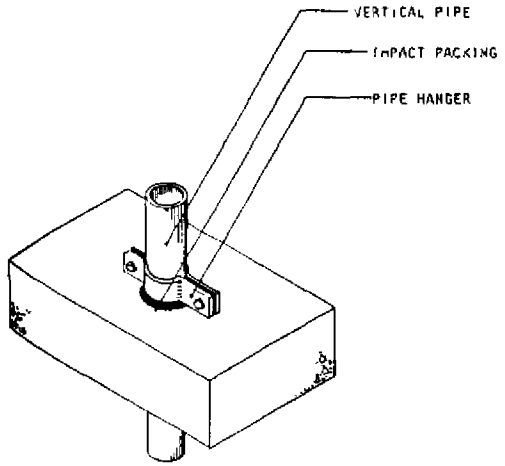


FIGURE 4.89. Piping systems. Horizontal laterally braced pipe hanger.



NOTE: The Design Team may wish to consider allowing slight longitudinal movements with damped restraints

FIGURE 4.90. Piping systems. Horizontal pipe hanger with longitudinal bracing.



NOTE. Rigid attachment to the structural floor increases potential for pipe failure

FIGURE 4.91. Piping systems Vertical pipe hanger.

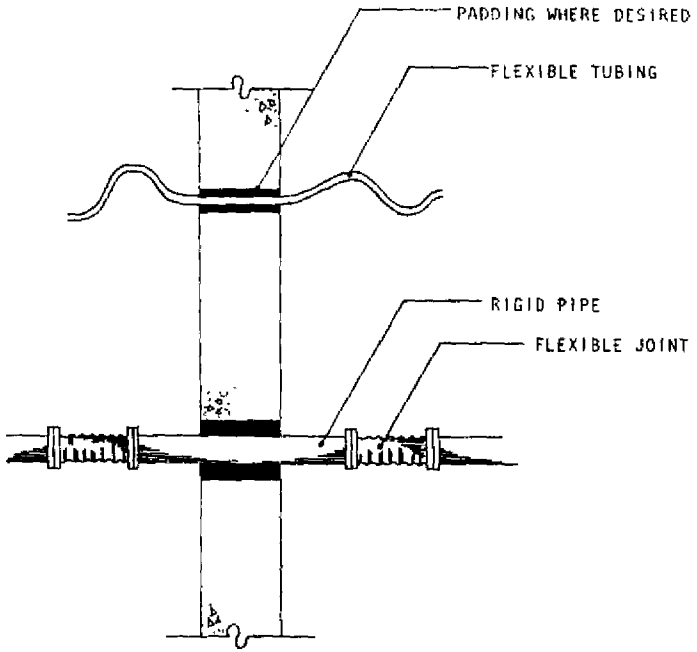
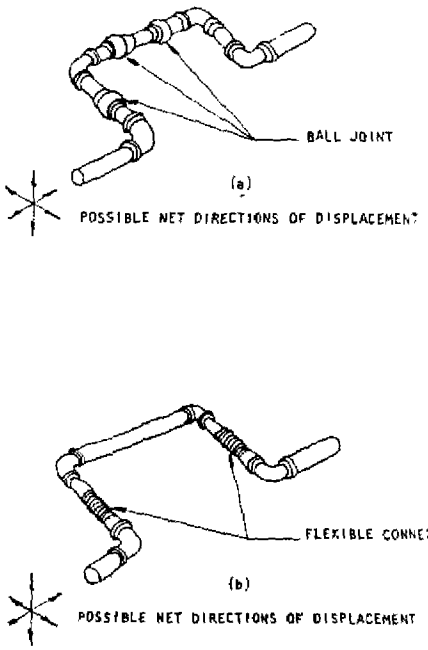


FIGURE 4.92. Piping systems. Piping and tubing at wall Flexible allowances also applies to floor interfaces.



FROM Ayres & Sun, "Nonstructural Damage , San Fernando, CA, Earthquake of Feb 9, 1971, Vol I, Part B, N.O.A.A., Washington, D.C , 1973, Page 759

FIGURE 4.93 Piping systems. Piping at seismic joint.

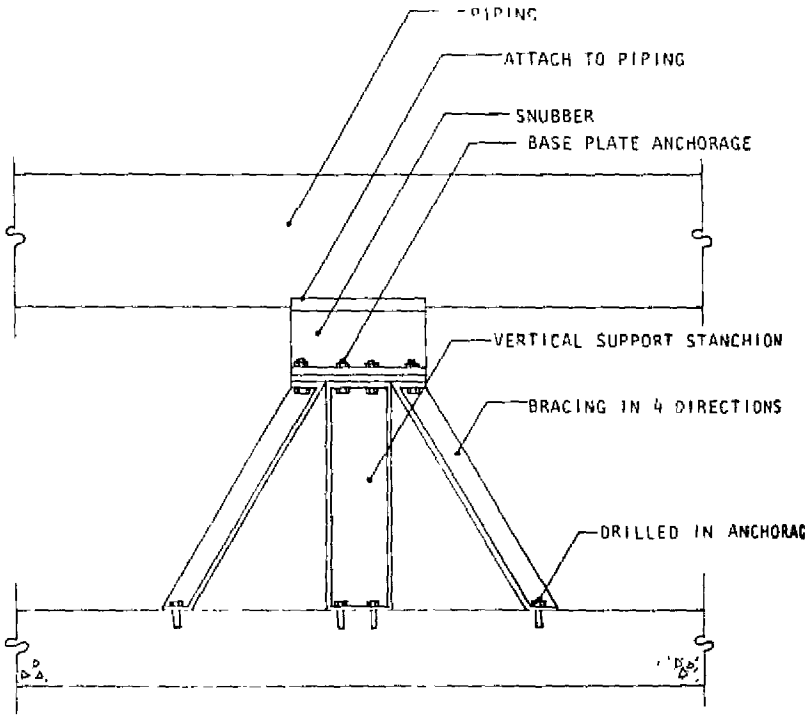


FIGURE 4.94. Piping systems. Seismic bracing for stanchion-mounted pipes. (Courtesy Mason Industries, Inc.)

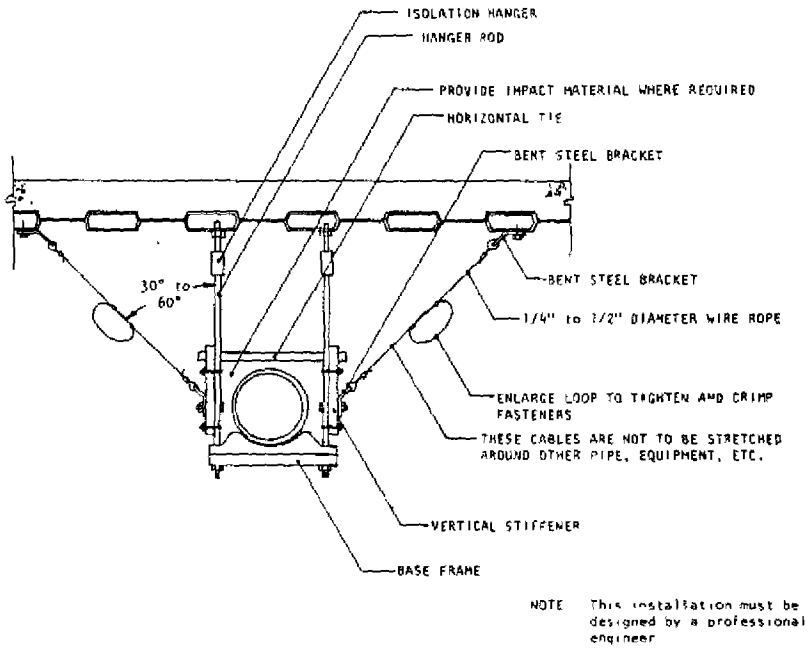


FIGURE 4.95. Piping systems. Sway bracing for the seismic environment. (Courtesy Mason Industries, Inc.)

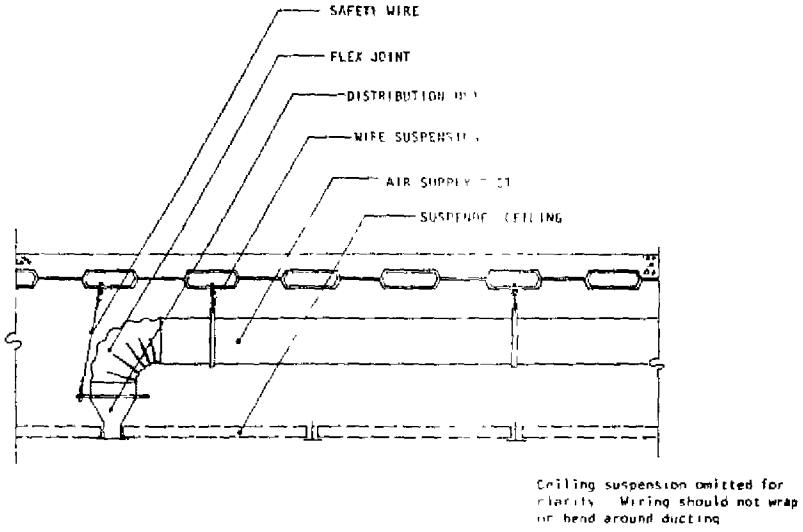


FIGURE 4.96. Suspended ceiling systems. Air distribution for integrated ceiling system.

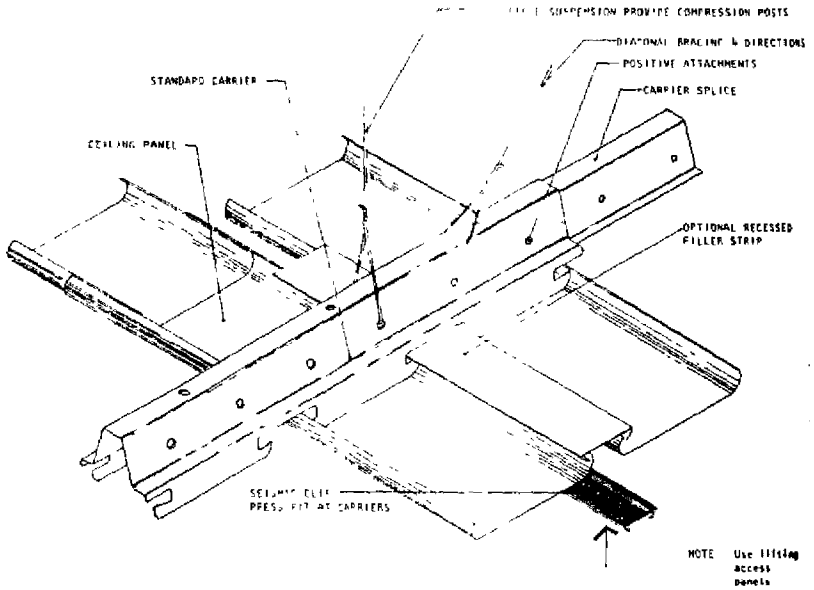


FIGURE 4.97. Suspended ceiling systems. Metal ceilings. (Courtesy Alcoa Aluminum Ceiling Systems.)

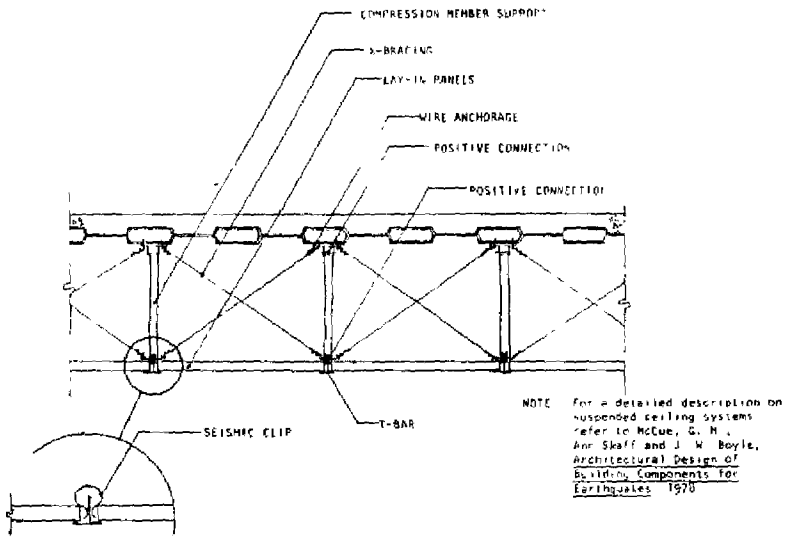


FIGURE 4.98. Suspended ceiling systems. T-bar and acoustic lay-in ceiling suspension system.

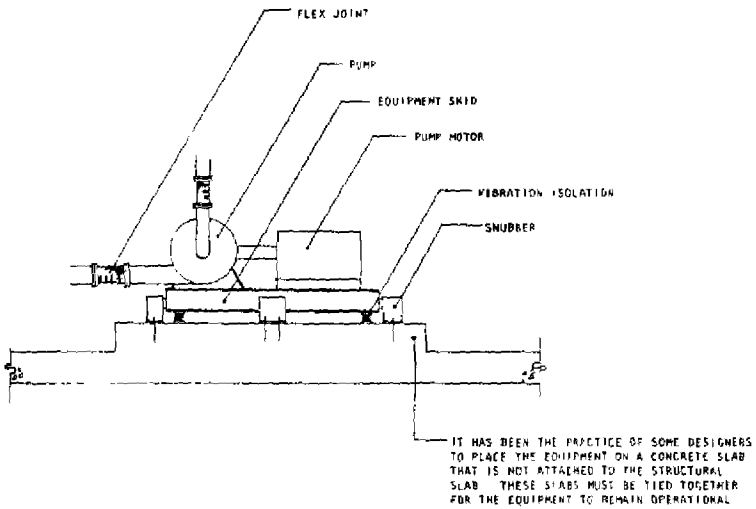


FIGURE 4.99. Water systems. Small reciprocating machinery installation.

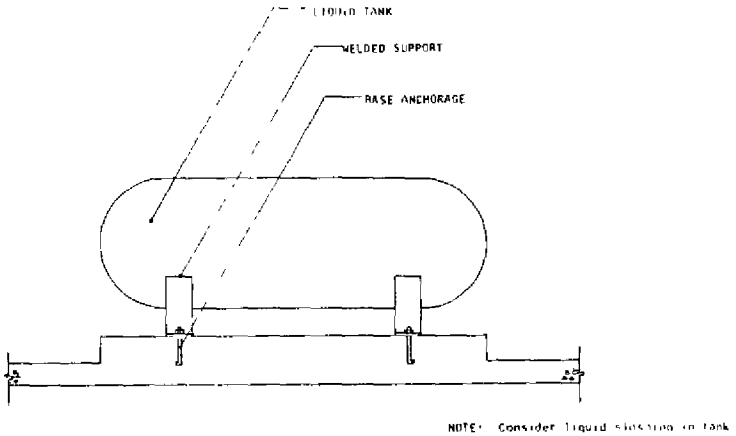


FIGURE 4.100. Water systems. Installation of horizontal liquid tanks.

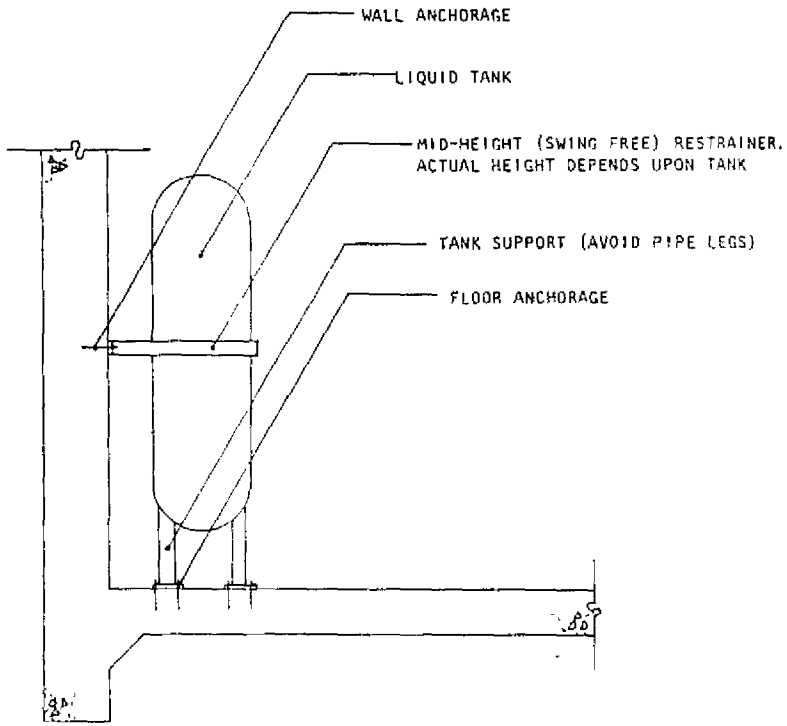
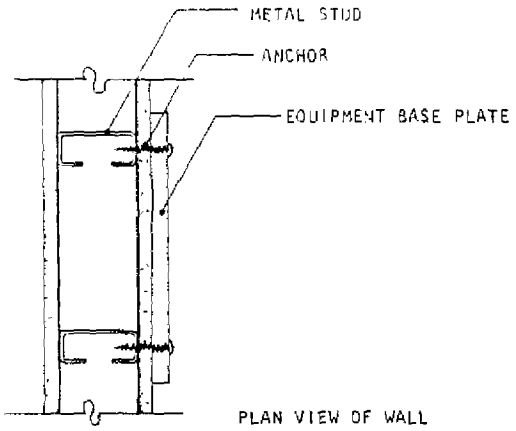


FIGURE 4.101. Water systems. Anchorage of upright liquid tanks to structural walls



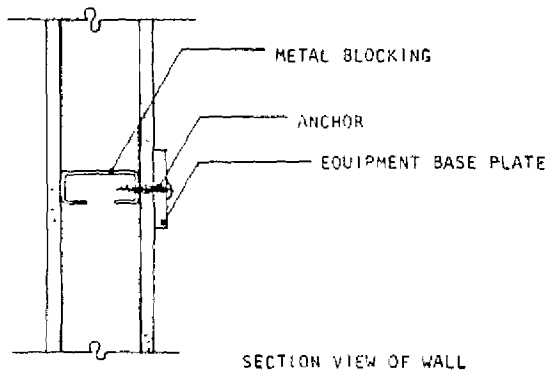


FIGURE 4.102. Miscellaneous systems. Plan and section views showing equipment anchorage to metal stud partition walls

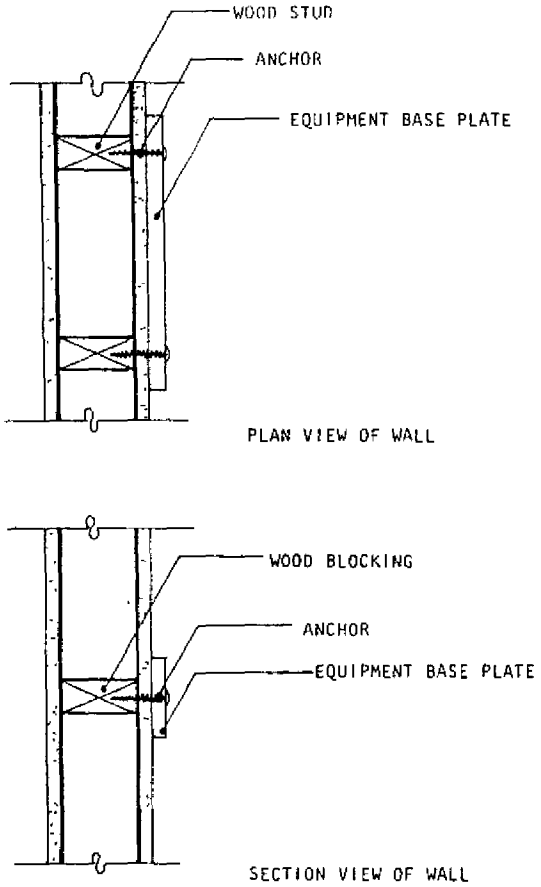


FIGURE 4.103. Miscellaneous equipment. Plan and section views showing equipment anchorage to wood stud partition walls.

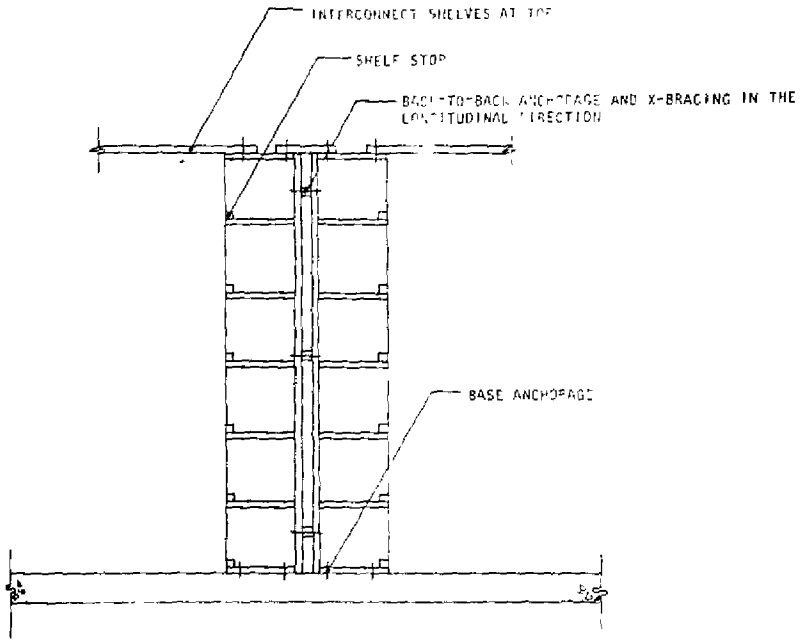


FIGURE 4.104. Miscellaneous equipment. Book shelf anchorage.

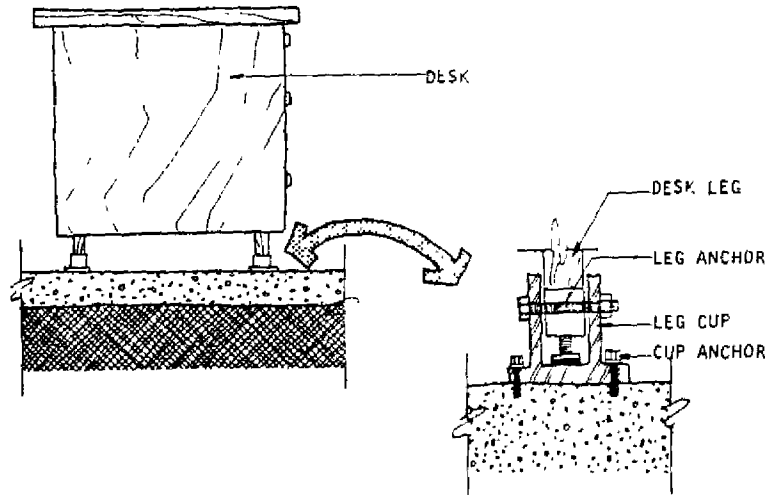


FIGURE 4.105. Miscellaneous equipment. Permanent desk installation.

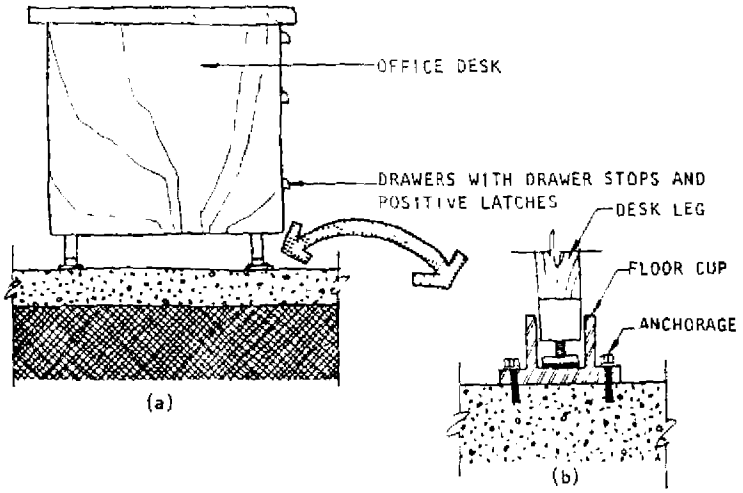


FIGURE 4.106. Miscellaneous equipment Nonpermanent office desk floor cups.

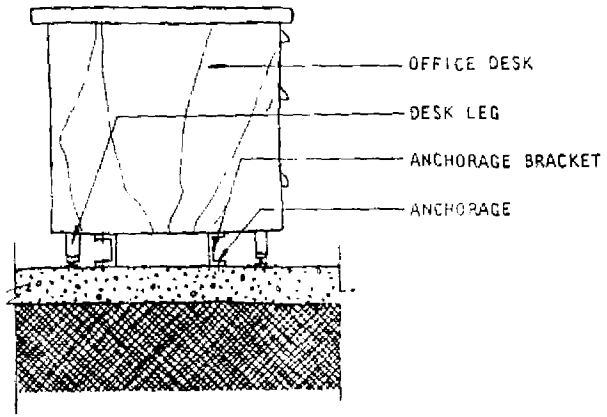


FIGURE 4.107. Miscellaneous equipment Permanent desk installation

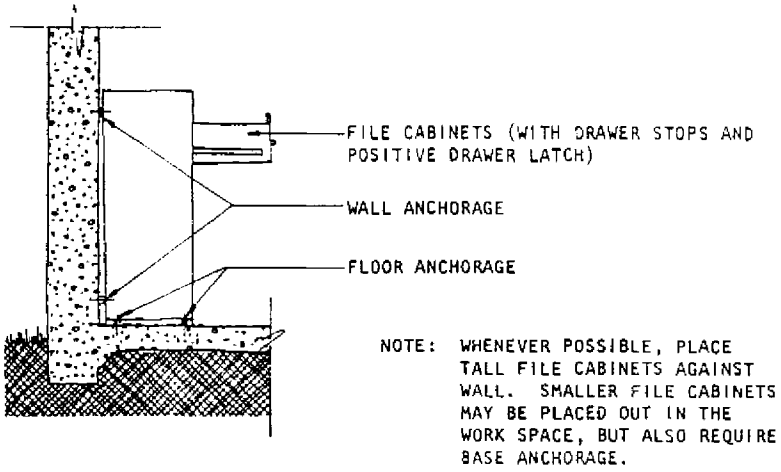


FIGURE 4.108. Miscellaneous equipment. File cabinet installation.

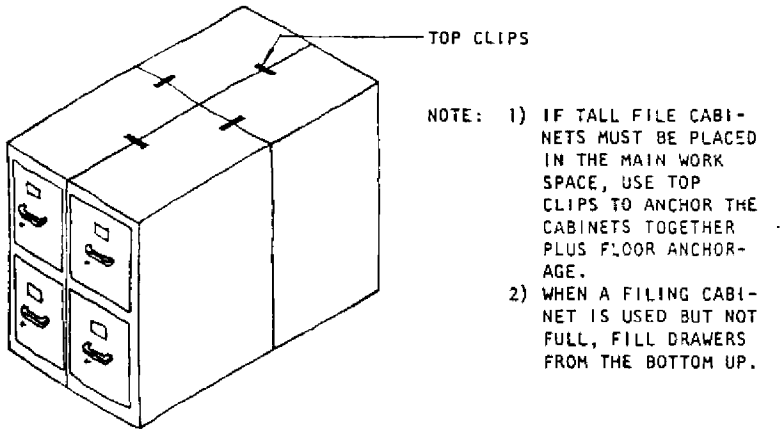
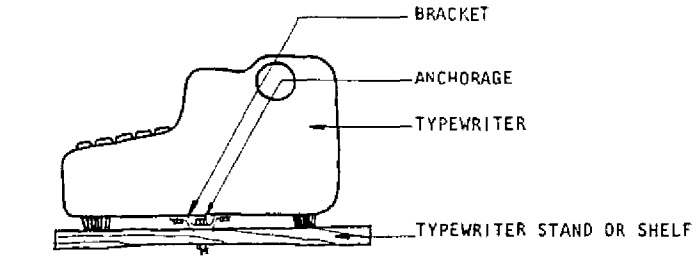
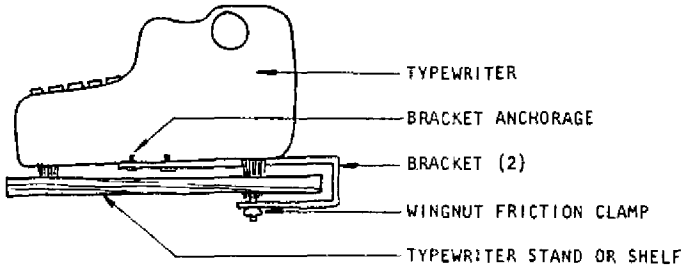


FIGURE 4.109. Miscellaneous equipment File cabinet interanchorage. Adapted from Stone, Marraccini and Patterson, 1976



(a)

PERMANENT INSTALLATION



(b)

NONPERMANENT INSTALLATION

FIGURE 4.110. Miscellaneous equipment. Typewriter installation to prevent dislocation. Adapted from Stone, Marracciní, and Patterson, 1976