FLOOR AND CEILING ANCHORS

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1. GENERAL

1.01 This section discusses and provides standards for floor and ceiling anchors. These standards are provided for use in the design of new buildings or building additions that are intended to house telephone equipment that meets the requirements of Section 800-610-164, "New Equipment-Building System (NEBS), General Equipment Requirements."

1.02 This section supersedes Section 6-4 of Specification X-74300, "NEBS Building Engineering Standards (BES)." Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 Floor and ceiling anchors are used to secure communications and building equipment to the floors to prevent movement and to support mechanical and electrical assemblies from the ceiling.

1.04 Under the New Equipment-Building System (NEBS)—General Equipment Requirements, Section 800-610-164, equipment frames are secured to the floors and the dedicated cable distribution system is supported by the tops of the frames in equipped areas. In nonequipped areas, the dedicated cable racks are usually stanchion-supported. The via cable distribution system is designed to be supported by equipment frames or stanchions. In nonequipped areas or where via cables traverse office areas, they should be hung from rods that are attached to ceiling anchors or channels that have been cast into the concrete ceiling.

1.05 In addition to possibly supporting via cable racks, ceiling anchors or channels will be required to support conduits, lights, and the suspended ceiling of the Modular Cooling System (MCS). Anchor points should be provided in all areas in a predetermined grid to meet these needs. Some items, such as the house service conduits, building lighting, and suspended ceilings may be contractor-installed. Using ceiling anchors or channels in this manner requires coordination with Western Electric cabling and superstructure plans.

1.06 In general, it is recommended that ceiling inserts or channels be installed in the specified pattern over all areas of the Central Office. In areas of the country where Zone 4 seismic activity is likely, the ceiling anchor elements may be required to provide auxiliary bracing to withstand the additional seismic loadings. Deviation from this standard requires a careful assessment of the office by the operating company and coordination with Western Electric. For example, for a single-story building in a nonearthquake area not planned for vertical growth and employing conventional air-conditioning, ceiling inserts can be eliminated because of the small amounts of via cabling. Stanchions can be used in place of ceiling supports

in this case. It is recommended, however, that for all multistory buildings, ceiling anchors be provided everywhere to provide for the large amounts of house service systems and for via cabling over unequipped areas.

1.07 Ceiling-supported air-conditioning ducts are usually installed by the mechanical contractor. Separate ceiling anchors are recommended for this purpose because of the large numbers usually required to support the ducts. In addition, the ducts must be located to avoid obstructing the ceiling anchors that support Central Office facilities. In those areas where duct work unavoidably covers ceiling inserts, provisions must be made to enable these inserts to be used.

2. TYPES OF ANCHORS

2.01 Two types of anchors are recommended for use in Central Offices: cast-in-place anchors in the ceilings and self-drilling anchors in the floor. Other types, such as the expansion types that are placed in predrilled holes, may be used where it is not feasible to use the recommended types. Explosive-driven studs are not acceptable for anchoring equipment frames or bracing details to floors or ceilings; their use is to be limited to mounting lightweight items, such as conduit.

CAST-IN-PLACE ANCHORS

2.02 Cast-in-place anchors are positioned in a ceiling by fastening them to the wood forms before the concrete is poured. After the concrete is poured and sufficiently cured, the forms are removed and the anchors are ready for use. The exposed threaded opening should be covered with a snap-in type button to prevent paint or other material getting into the interior of the insert and damaging the interior threads.

2.03 Cast-in-place anchors may consist of individual internally threaded inserts made of cast iron or steel and are receptacles for threaded rods or bolts. An alternate to the individual anchor is the channel-type or continuous insert. These channel-type inserts, of which UNISTRUT is the commonly used, contain anchor tabs which are an integral part of the channel structure and are specifically designed for concrete embedment. The channels act as retainers for spring-loaded nuts to which threaded rod or anchor bolts are attached.

2.04 Attachment of UNISTRUT or equivalent type channels to the ceiling through existing embedded anchors are not recommended for use other than for supporting loads less than about 100 pounds. Additionally, the use of embedded channels not specifically designed for installation in concrete are not acceptable.

2.05 Figure 1 shows the cast-in-place anchors that have been tested at Bell Laboratories. Table A lists the properties of the receptacle type of anchor and the average failure loads when such anchors are tested in 3000-psi (28-day compressive strength) concrete. Table B lists the properties and point failure loads of embedded channel-type anchors tested in 3000-psi concrete.

PREDRILLED-HOLE ANCHORS

2.06 Predrilled-hole anchors, shown in Fig. 2, are positioned in drilled and cleaned holes in the concrete. Expanding an anchor laterally against the wall of the hole provides resistance against pullout loads. One such anchor, an expansion shield consisting of a shell split lengthwise and a threaded plug, acts as a below-surface receptacle for threaded rods or bolts. A second type, a stud with an external expansion ring, acts as a protruding threaded stud. Table C summarizes the properties and average ultimate failure load capabilities of the predrilled-hole anchors tested at Bell Laboratories.

SELF-DRILLING ANCHORS

2.07 Self-drilling anchors, shown in Fig. 3, are similar to the predrilled-hole receptacle types except that they drill their own hole during installation. Table D lists the properties and average load capabilities of the self-drilling anchors tested at Bell Laboratories.

3. SELECTION OF TYPE OF ANCHOR

3.01 Selection of the type of anchor to use depends on the load requirements and the cost per anchor. The major factor that determines the cost of an anchor is the installation time required. As installation becomes easier, the cost per anchor decreases. Cast-in-place anchors are installed easily on the lower or ceiling surface of a concrete slab, but are difficult to install on the upper or floor surface of the slab. The installation predrilled-hole anchors require close supervision to ensure a properly set insert. A slightly oversized or

Fig. 1—Cast-In Place Anchors

out-of-round hole or insufficient dust removal can greatly reduce the load-carrying capability of the installed anchor.

3.02 Self-drilling anchors require the same installation time as predrilled-hole anchors but require less care during installation. Both types must be relocated if a steel reinforcing rod is encountered during the drilling.

3.03 Self-drilling types are recommended as floor anchors to fasten equipment frameworks, since they meet the load requirements and are more reliable than predrilled-hole anchors.

4. SAFE WORKING LOADS

4.01 Tables A through D show average tensile failure loads determined from tests. For design purposes, safe working loads are set at one-fourth the failure-load levels to account for variations in materials, workmanship, reliability in load prediction, etc.

5. LOCATION OF CEILING ANCHORS

5.01 Cast-in-place ceiling anchors offer substantial benefits in load-carrying capability and in installed cost compared with anchors placed by drilling the structural slab after construction. Cast-in-place anchors located in a repeating grid pattern in a ceiling offer additional advantages in that the erection and subsequent fastening of overhead framing and mechanical and electrical assemblies is greatly facilitated. The grid pattern used for a flat-slab floor is shown in Fig. 4. This pattern also can be used in two-way solid-slab and beam-and-slab floors.

5.02 In the ceiling insert plan shown in Fig. 4, the anchors are spaced on 5-foot centers in lines that run perpendicular and parallel to the equipment lineups. Sixteen anchors should be provided in each typical building bay of a Central Office equipment room. Where many additional ceiling anchors are needed to support house service systems and air-conditioning distribution ducts of the conventional cooling systems or the suspended ceiling of the MCS, an embedded channel system should be considered. Figure 5 shows the locations of UNISTRUT-type channels in the ceiling before the casting of the floor structure. Channels positioned on lines that are perpendicular to the axis of the between-column cable holes will allow for support of air ducts that run parallel to the line of the cable holes.

TABLE A

CAST-IN-PLACE ANCHORS

ANCHOR TYPE AND MANUFACTURER	APPROX PRICE/100 ($, 1976)	MATERIAL	AVG TENSILE FAILURE LOAD* (LB)
RICHMOND SCREW ANCHOR:			
Kohler	$ 87.	Gray cast iron	12,750
Bell	190.	Malleable iron	18,250
LFW	87.	Steel	13,450
Rocket	204.	Malleable iron	17,500
ELCEN METAL PRODUCTS:			
Spot Type	150.	Malleable iron	16,200
HOHMANN & BARNARD:			
Mitey-Mite Threaded Insert #58	81.	Malleable iron	6,000
Threaded Insert #HE	85.	Gray iron	12,000
Threaded Insert #HE-MI	110.	Malleable iron	17,000
STAR EXPANSION:			
P-45T	36.	Zinc alloy	8,100
P-46T	62.	Zinc alloy	17,000
REPUBLIC STEEL:			
5/8" Tapped Insert	50.	Pressed Steel	12,500
FIREPROOF PRODUCTS:			
5/8" LMC	150.	Malleable iron	20,000

* Measured in 3000 psi (28-day compressive strength) concrete.

Note: All Inserts have Receptacles for 5/8-Inch Diameter Threaded Rods.

TABLE B

CONTINUOUS CHANNEL-TYPE CAST-IN-PLACE ANCHORS USING CHANNEL VENT FOR 5/8-INCH DIAMETER THREADED RODS

ANCHOR TYPE AND MANUFACTURER	PRICE/FT* ($, 1976)	AVG. CONCENTRATED FAILURE LOAD PER BOLT AT 8-INCH SPACINGS (LB)
UNISTRUT:		
P3200 Series	2.00	9,000
P3300 Series	1.69	6,000

*Based on 20-foot length; does not include associated hardware.

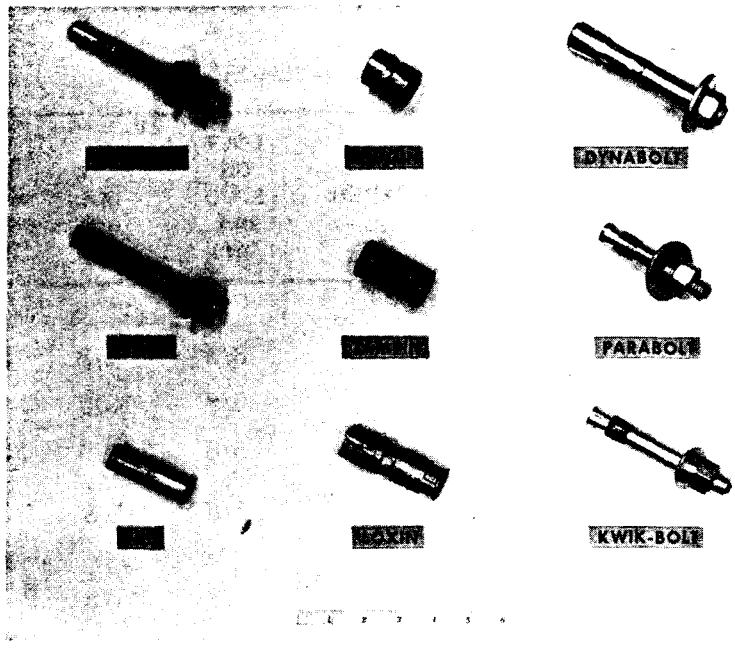

Fig. 2—Predrilled Hole Anchors

6. FLOOR INSERTS FOR RAISED FLOOR SYSTEMS

6.01 Raised floor systems in Central Offices can be outfitted with threaded floor inserts for fastening equipment frames, cable rack support stanchions, framework end guards, and other floor-mounted equipment. Typical methods of installation of inserts and equipment are shown on Drawing ED-97804-01, Sheet 19. Inserts can be either factory-installed into individual floor panels or field-installed to accommodate varying equipment positions, floor plan changes, and other on-site requirements. With a fixed floor plan and a totally engineered raised floor system, support panel locations are planned to individually position and support equipment frames in modular arrangement. (See Fig. 6.)

6.02 Inserts must have sufficient strength to adequately restrain a maximum-weight equipment frame against overturning moments generated by installation and normal use loads (cable pulling in the framework-supported cable racks, people leaning against frames, attachment of miscellaneous equipment shelves, etc). Factory-installed inserts should not project from the body of the floor panel to facilitate panel handling during manufacture and installation (see ED-97804-01, Sheet 18). However, when inserts are field-installed into panels in fixed locations, a slight projection of the insert flange or body is tolerable (see Fig. 7). Either method of installation should ensure a pull-out resistance capability of at least 3000 pounds and a torque resistance of 350 pounds-inches or more. Western Electric Installation Handbooks describe methods of installation and tool requirements for these inserts.

7. INSULATION EFFECTIVENESS

7.01 For electric-type Central Office equipment systems that require isolated (floating) grounds, the framework is insulated from both permanent building and raised floors by the use of insulating details. (See ED-97785-30 for UNIFRAME frameworks and ED-1A210-20 for ESS and Unequal Flange frameworks.)

8. FLOOR AND CEILING ANCHOR STANDARDS

NONEARTHQUAKE AREAS

8.01 Equipment floor anchors in concrete floors must withstand an average tensile failure load of 4000 pounds.

TABLE C

PREDRILLED-HOLE ANCHORS

ANCHOR TYPE AND MANUFACTURER	COST/ HUNDRED ($, 1976)	MATERIAL	BOLT OR STUD DIA. (IN.)	HOLE DIA. (IN.)	MIN. HOLE DEPTH (IN.)	AVG. TENSILE FAILURE LOAD* (LBS.)
STAR EXPANSION INDUSTRIES:						
Loxin #3625-003	30.	Zinc alloy	3/8	5/8	2	3,925
Loxin #3645-002	58.	Zinc alloy	5/8	1.00	2-1/2	6,125
Loxin #3645-003	88.	Zinc alloy	5/8	1.00	3	7,000
Tampin #4045-00	58.	Lead sleeve and metal cone	5/8	1-1/8	1-3/4	8,750
Slugin #6845-002 with #6845-003	23. 28.	Lead sleeve and alloy cone	5/8	1-1/8	2-3/16	6,500
WEJ-IT:						
Ankr-Tite-3830	14.	Steel	3/8	3/8	2-1/2	5,300
Ankr-Tite-3852	20.	Steel	3/8	3/8	3	6,250
Ankr-Tite-5843	44.	Steel	5/8	5/8	4	9,500
Wej-It #5842	130.	Steel	5/8	5/8	4-1/2	6,875
HILTI CORP.:						
TZD 1/4-20	24.	Steel	1/4	5/16	1	1,500
TZD 3/8-16	37.	Steel	3/8	7/16	1-9/16	3,438
TZD 1/2-13	55.	Steel	1/2	9/16	2	5,625
TZD 5/8-11	84.	Steel	5/8	3/4	2-3/8	6,938
Kwik-Bolt #58-412	125.	Steel	5/8	5/8	2-3/4	5,750
USM CORP.:						
Parabolt 38-334	54.	Steel	3/8	3/8	1-1/2	4,063
Parabolt 38-5	63.	Steel	3/8	3/8	1-1/2	4,438
Parabolt 58-312	113.	Steel	5/8	5/8	2-3/4	6,625
Parabolt 58-5	129.	Steel	5/8	5/8	2-3/4	11,250
RAMSET:						
#5022 Dynabolt	43.	Steel	3/8	1/2	1-1/2	4,250
#6222 Dynabolt	64.	Steel	1/2	5/8	2	7,250
#7524 Dynabolt	102.	Steel	5/8	3/4	2-1/4	8,000
#7542 Dynabolt	128.	Steel	5/8	3/4	2-1/4	9,875

* Measured in 3000 psi (28-day compressive strength) concrete.

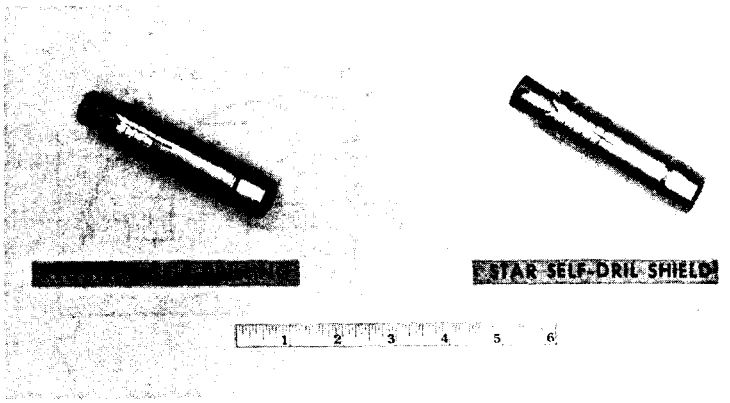

Fig. 3—Self-Drilling Anchors

TABLE D

SELF-DRILLING ANCHORS

ANCHOR TYPE AND MANUFACTURER	COST/ HUNDRED ($, 1976)	MATERIAL	BOLT OR STUD DIA. (IN.)	HOLE DIA. (IN.)	MIN. HOLE DEPTH (IN.)	AVG. TENSILE FAILURE LOAD* (LBS.)
PHILLIPS DRILL CO.:						
S-14 Self-Drilling	29.	Steel	1/4	7/16	1-3/32	3,125
S-16 Self-Drilling	39.	Steel	5/16	15/32	1-5/16	3,750
S-38 Self-Drilling	46.	Steel	3/8	9/16	1-17/32	4,710
S-12 Self-Drilling	70.	Steel	1/2	11/16	2-11/32	6,181
S-58 Self-Drilling	120.	Steel	5/8	27/32	2-15/32	9,128
STAR EXPANSION INDUSTRIES:						
Chuck End 3425	26.	Steel	3/8	9/16	1-17/32	4,146
Chuck End 3435	43.	Steel	1/2	11/16	2-1/32	6,341
Chuck End 3445	62.	Steel	5/8	27/32	2-15/32	10,016

* Measured in 3000 psi (28-day compressive strength) concrete.

8.02 Wherever possible, use self-drilling inserts to fasten equipment frameworks to concrete floors.

8.03 Use any of the cast-in-place anchors listed in Tables A or B for ceiling anchors.

8.04 Safe working design loads shall be one-fourth of the average tensile failure load.

8.05 Equipment floor inserts in the panels of raised floors must withstand a minimum tensile failure load of 3000 pounds.

EARTHQUAKE AREAS (SEE SECTION 760-200-023 AND ED-97865-01)

8.06 For electronic equipment installed in Earthquake Zones 3 and 4, self-drilling floor anchors

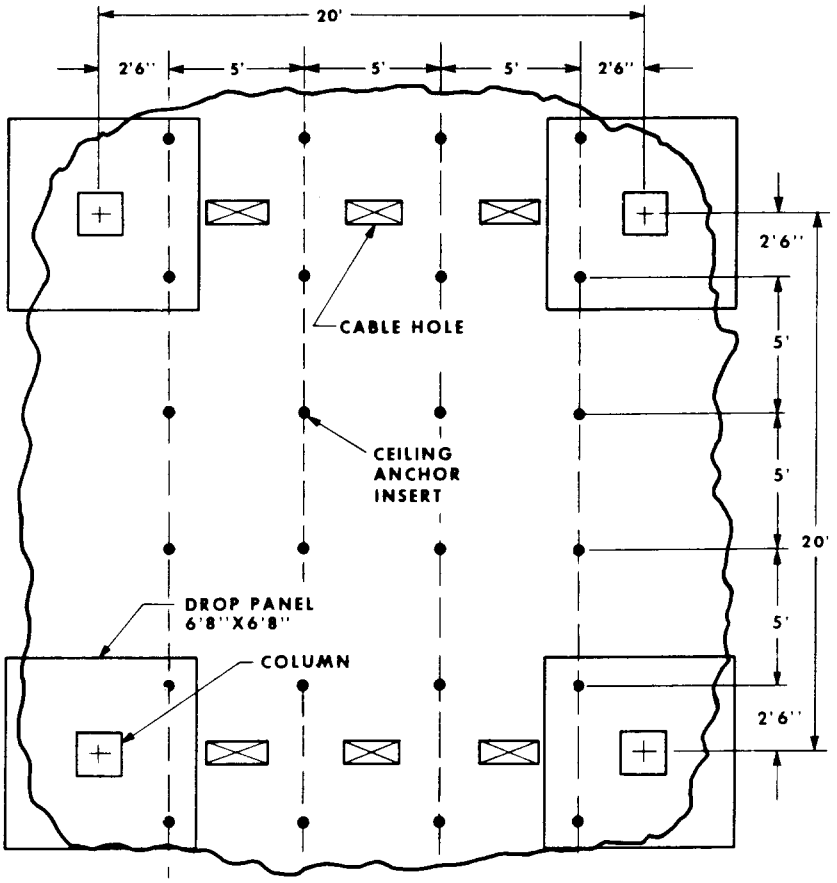

Fig. 4—Section of Equipment Room, Showing Location of Anchors

must withstand an average static tensile failure load of 6000 pounds.

8.07 In Zone 4 areas, use cast-in-place anchors to fasten equipment bracing to building ceilings.

8.08 All connections of overhead earthquake bracings to building ceilings shall use cast-in-place anchors capable of withstanding a minimum average static tensile failure load of 18,000 pounds.

8.09 Use cast-in-place anchors of malleable iron or steel.

INSTALLATION

8.10 Cast-in-place anchors:

(a) Install anchors flush with the concrete surface.

(b) Protect anchors from filling up with dirt or concrete by masking the tapped hole in the insert.

8.11 Self-drilling anchors: (See ED-97865-01.)

(a) Relocate hole if a reinforcing bar is struck during drilling.

(b) Clean hole thoroughly before setting the anchor.

(c) Insert the anchor so that it does not protrude above the surface of the concrete.

8.12 Predrilled-hole anchors:

(a) Use masonry drills that provide round, smooth holes of the correct size.

(b) Relocate hole if a reinforcing bar is struck during drilling.

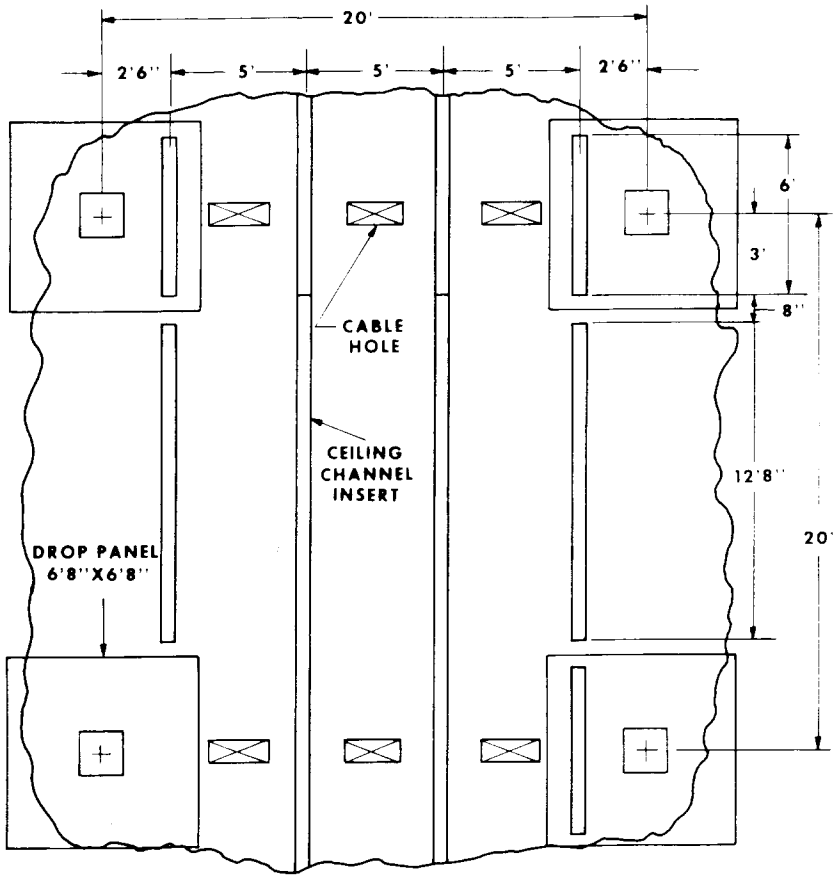

Fig. 5—Section of Equipment Room Showing Location of Channel Inserts (UNISTRUT) for Each 20′ × 20′ Bay

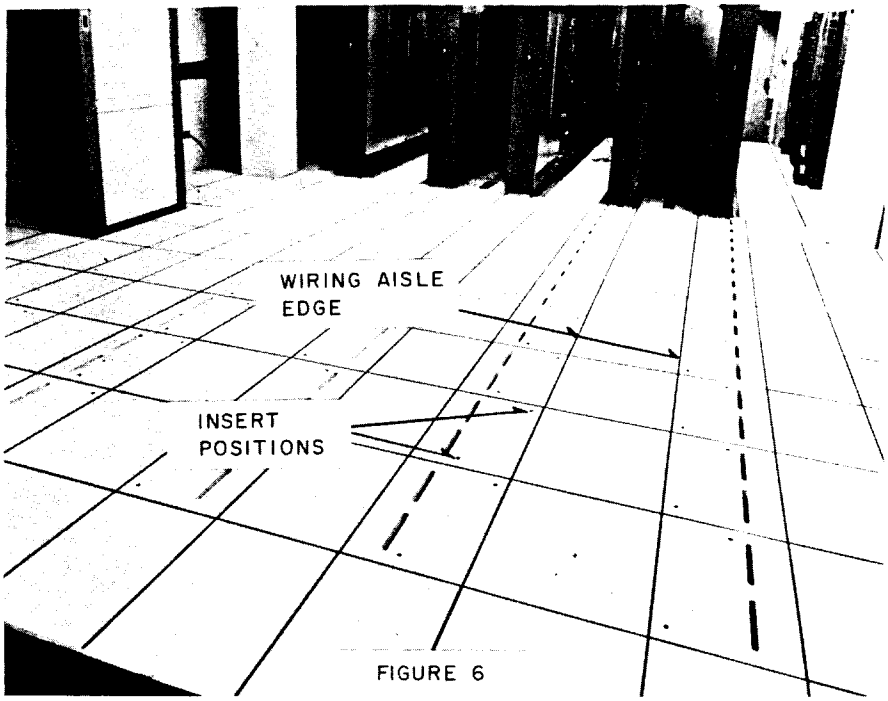

Fig. 6—Support Panel Locations for Fixed Floor Plan and Raised Floor System

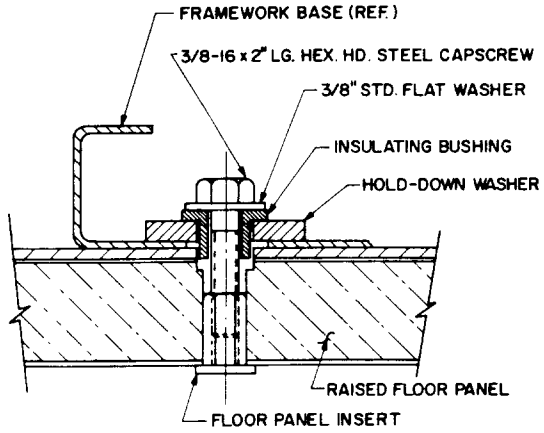

Fig. 7—Typical Frame Hold-Down for Installation on Wood-Core Floor Panels

(c) Clean hole thoroughly before inserting the anchor.

(d) Tighten the anchor to the recommended torque to provide the specified load-carrying capability.

8.13 Raised floor inserts:

(a) Factory-install inserts in panels where preplanning permits.

(b) Field-install inserts by prescribed Western Electric methods when varying conditions of equipment location exist.

9. REFERENCES

1. ***Installation Engineering Handbook 30,*** Western Electric Company

2. "Mechanical Fasteners for Concrete," American Concrete Institute, SP-22, 1969

3. "MCS Installation Instructions," ED-97804-01.