NETWORK EQUIPMENT
ANCHORING REQUIREMENTS

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1. GENERAL

1.01 This section provides the guidelines for materials and methods used to secure network equipment in network buildings and equipment areas. The guidelines provide generic procedures for anchoring equipment frameworks to the building and the maintenance requirements for anchoring hardware and building concrete. All network elements installed in the central office, data centers, operator service centers and customer premise locations shall be secured to the building.

1.02 Document re-released as merged practice amd renumbered from PBS-000-101PT to BSP 800-000-101MP incorporating requirements for Nevada Bell/Pacific Bell/Southwestern Bell.

1.03 The guidelines are applicable to new equipment installed in network equipment buildings and spaces, data centers, operator services centers and customer premises when placed on building concrete floors. Equipment placed on raised floors systems, i.e. data room access floors, shall follow securing procedures in BSP 800-000-104MP*, Bracing Requirements for Network and Data Equipment on Raised Floor System*.

1.04 Secured equipment minimizes risk of overturning or displacement and improve service reliability. Securing equipment reduces risk to personnel, service outage and product damage that may result from unbalanced loads, earthquakes, accidental collisions and building vibration.

1.05 Maintenance requirements outline inspection and repair procedures for anchors and building concrete. Anchor repair and removal procedures are specified for various styles of anchors used with telecommunications equipment. Repair materials for use in equipment buildings are specified.

2. SECURING EQUIPMENT

A. Requirements

2.01 All equipment permanently installed in the central office, data center, operator service centers and customer premise locations shall be secured to building structure.

2.02 Equipment securing requirements are specified in Bell Service Practice BSP 800-068-150MP, *Central Office Equipment Framework Support Requirements* or on equipment manufacturers' installation drawings. Telephone company Equipment Engineer shall obtain installation requirements from equipment manufacturer or use as minimum, securing requirements in Bell Service Practice and Technical Publication.

2.03 Equipment temporarily placed at jobsite awaiting:

A.) Assembly or cabling
B.) Moving into permanent position
C.) Installation of anchor holes and anchors

may be stored at the jobsite with non permanent securing procedures. Temporary placement shall not exceed 7 days. Equipment stored for longer periods shall be installed using permanent securing methods or stored away from operating network equipment and occupied areas.

2.04 Accepted temporary placement procedures include:

1. Store away from network equipment and occupied areas in original shipping packaging.
2. Place equipment in more stable position such as lying horizontally on floor.
3. Support equipment with constructed temporary bracing that will prevent overturning or toppling.
4. Secure upright frames to overhead auxiliary framing with straps.
5. Battery stands, cabinet mounted equipment and equipment configurations other than upright framework shall be secured with straps to building columns, walls or to overhead auxiliary framing.
6. Temporary floor anchoring with 1/2 inch Kwik-Bolt II or 1/2 inch HDI anchors may be used to secure equipment while awaiting permanent installation.

2.05 Equipment secured to auxiliary framing or building shall use webbed polyester/nylon or equal straps of at least 1 inch width. Straps and buckles shall be rated for minimum 1000 pounds tensile strength. Weblock buckles shall not slip up to rated strap tensile loads. Equipment shall never be suspended from overhead auxiliary framing, that is without weight of frame supported on floor.

2.06 Equipment installed for field trials, temporary service, testing in the normal equipment environment shall be installed with permanent securing methods.

2.07 Freestanding equipment frames shall be secured with floor anchors designed to resist overturning, walking or rocking loads. The proper anchor size, number of anchors and anchor style shall be specified by equipment manufacturer on installation drawings or as minimum anchoring requirements stated in this document.

2.08 Older equipment with supplemental support from overhead framing must account for overhead structure movement or swinging of up to 12 inches peak to peak. Floor anchor placement shall be chosen to avoid anchor failure or loosening due to frame movement with overhead structure.

2.09 All equipment frameworks shall be designed and installed in equipment buildings without supplemental overhead support. In **High Seismic Risk** locations (Zones 3,4) equipment shall be capable of a single earthquake event up 1.5G and 3 aftershock events of 1.0G. In **Low Seismic Risk** locations (Zones 0,1,2) equipment shall be capable of ground motions to .50G.. In **Low Seismic Risk** locations equipment securing primarily prevents overturning framework due to unbalanced loads or inadvertent impact.

B. Generic Framework Securing Requirements

2.10 Unequal flange steel frame work of 7 feet height installed with up to 400 pounds of mounted equipment shall be secured with four (4) Hilti 12mm HSL anchors as shown in Fig. 1. for **High Seismic Risk** locations or four (4) Hilti HDI ½ anchors for **Low Seismic Risk** locations. Framework used for installation of network equipment in all company facilities shall be designed for **Seismic Zone 4** service. Combined frame/equipment weight exceeding 500 pounds requires larger anchors or weight redistributed.

2.11 Steel channel type frame of 7 feet height with angle base installed with up to 100 pounds of mounted equipment shall be secured with four (4) Hilti 12mm HSL anchors at base corners as shown in Fig. 2. for **High Seismic Risk** locations or four (4) Hilti HDI ½ anchors for **Low Seismic Risk** locations.For Channel frame shall be welded construction when installed in a freestanding configuration. Combined frame/equipment weight cannot exceed 150 pounds in freestanding configuration.

2.12 Battery stands, DC power distribution panels, rectifiers, fuse panels and other network power equipment shall be secured with Hilti 16mm HSL anchors for **High Seismic Risk** locations or four (4) Hilti HDI ½ anchors for **Low Seismic Risk** locations as shown in Fig. 3., or in accordance to quantities specified by the equipment manufacturer. Number of anchors for battery stands will vary with stand manufacturer.

2.13 11'-6", 9'-0" height frames or other equipment requiring overhead support shall have anchors placed with provision for base movement. Anchors shall be configured along upright centerline as shown in Fig. 4. to permit base to pivot around anchors.

3.0 BUILDING SPECIFICATIONS

A. Floor Construction

3.01 Existing company equipment buildings have reinforced concrete floors, poured or precast. The nominal thickness of floor slabs will be 5 inches with actual thickness ranging from 4 inches to 8 inches. Most floors will be at least 5 inches thick permitting anchor depths to 4-1/2 inches. Buildings with shallower floors may not allow normal anchor use.

3.02 Concrete floors in existing buildings will have normal weight aggregate concrete of 3000 psi compressive strength minimum. Lightweight aggregate concrete may be found in buildings with subsequent vertical additions or when weight of structures were of concern. Lightweight concrete may have equal compressive strength of normal concrete but with reduced anchor retention values. Lightweight concrete can be identified by porous aggregate or reduced aggregate in mix.

3.03 Reinforcement steel in concrete may be found 1 to 3 inch from concrete surface. Rebar typically will be placed in regularly spaced rectangular patterns. The distance between rebars range from 3 inches to 20 inches while majority of floors have rebar at 6 inch spacing. Rebar is

placed along two axis as shown on Fig 5. Rebar spacing increases density near building structural members such as building columns and load bearing walls. Most common rebar size will be 5/8 inch diameter, #5.

3.04 A layer of nonstructural concrete may be poured over the concrete floor similar to Fig. 6. up to 4 inches thickness. The filler layer may be used to level sloping floors, to resurface cracked/broken concrete or to add thickness to shallow floors. Fill material has very limited strength for embedded anchors. This material typically contains no aggregate and is not reinforced. Embedded anchors should always be secured into structural concrete.

3.05 Pan deck floors are commonly used in non equipment areas. Concrete is poured onto corrugated sheetmetal decking similar to sketch in Fig. 7. Reinforcement steel is laid parallel to deck corrugations with about 2 inch concrete cover. The overall depth of concrete may only be 2 inches at top of deck pan.

3.06 Slab on grade floors are poured directly onto gravel or sand bed over earth as pictured in Fig. 8. These floors are reinforced with steel bars. Concrete cover over rebars will be approximately 2 inches. Concrete thickness varies from 3 to 5 inches depending on form depth and gravel bed grade. Mounded gravel may result in patches of very thin concrete in some areas of the floor.

3.07 Wood floors may be used in smaller equipment buildings, trailers and customer premise locations. Floor construction may be plywood sheets or wood planks laid over wood floor joists or steel beams. Plywood sheets are typically 1 inch thick marine grade in 4 feet widths and up to 10 feet lengths. Wood planks may be tongue and grooved strips of 3/4 inch thick wood product. Nails or wood screws fasten wood floors to wood joists. Machine screws or self tapping screws secure floor to joists.

B. Floor Embedments

3.08 Electrical conduit or ducts may be embedded in equipment area floors as shown in Fig. 9. Conduit or ducts may have full length surface access covers or are completely embedded at 1 inch to 3 inch below surface. Size and shape of these conduits or ducts vary from round to rectangular up to 1 foot across. The conduit and ducts are placed in parallel patterns across floor. Embedded conduit or duct will not be visible at jobsite or depicted on building drawings except for possible surface access plates.

3.09 Water pipe may be embedded in concrete floors. Pipes in concrete could be embedded 1 to 3 inches from surface. There will be no obvious indication of pipe embedment in floor. Surface mounted water pipes on ceilings may be found. Water pipes will more commonly be found in administration buildings and customer premise locations than equipment buildings.

3.10 Structural steel may be found embedded in floors. Beams, channels, flat plate are encased in the concrete as part of the building support. These structures are most commonly located along floor joints, along column lines, against wall joints. Concrete cover over these members may be 1 to 3 inch. Real Estate architectural drawings of the building typically will indicate location of these structures. These structures should always be avoided when drilling for anchor holes.

3.11 Wire mesh may be embedded in concrete for reinforcement. The wire mesh may be light gauge steel of rectangular pattern embedded in entire floor area.

C. Floor Finish

3.12 Concrete floors in equipment areas are covered with floor tiles. These tiles are typically 12 inch square made of vinyl material secured to concrete floor with adhesive. Older floors may have tiles installed of other than 12 inch dimension. Adhesives used with older floor tiles may also contain asbestos. Asbestos materials shall always be worked and handled with precautions as stated in the TP76300, IJAH reference and industry safety documentation.

3.13 Sheet linoleum may be used to cover plywood floors and some concrete floors. The linoleum is glued in place or factory laminated to the plywood. Sheet linoleum is typically constructed of vinyl material secured to floor with adhesive.

3.14 Bare concrete floor may exist in some equipment areas such as engine generator rooms, power rooms, battery rooms, HVAC rooms. These floors may have painted surface or clear sealed surface as moisture barrier and for dust reduction.

D. Determining Floor Construction

3.15 Floor construction information is available from a number of resources. Installation contractor shall consult these resources before installing embedded anchors to determine if anchor installation problems may exist.

A) Contact DEC Resident engineer for any history of problems with equipment area.
B) Contact Company Real Estate Facilities Engineer for building drawings of floor construction or notes to equipment area.
C) Take a core sample of floor to determine material, depth and layers, if any exist. (Advise equipment engineer and facilities engineer of intent to develop core sample prior to start of drilling)
D) Install test samples of anchor and perform tension tests to 75 percent of ultimate anchor value for 3000 psi concrete.

4. DRILLING HOLES

A. Preparatory Activities

4.01 Drilling tools shall be double insulated for protection against accidental contact with electrical conductors. Tools not double insulated shall have ground fault interrupter on tool power line. Power for drilling tools shall be from properly fused building wall outlets. Equipment frame outlets shall never be used for powering installation tools.

4.02 Drill operator shall wear approved eye protection while operating tool. Eye protection shall prevent objects entering from sides as well as front. Eye protection devices shall conform to requirements stated in TP76300, IJAH (Safety).

4.03 Floor tiles in older buildings may be manufactured from asbestos material or mastic used to secure tiles may contain asbestos. If asbestos tiles are suspected at drilling location, contractor shall use procedures outlined in TP76300, IJAH handbook. The procedures require contractor to use methods that minimize asbestos release and dispose dust in an approved manner. Company Building Engineer should be contacted with any question on floor tile material or mastic.

4.04 Where 50 anchor holes or more are to be drilled in a 400 square feet area, it is a requirement that the floor be scanned for location of reinforcement steel prior to drilling. For projects of fewer than 50 anchors over 400 square feet, it is a recommendation the floor be scanned. Scanning devices such as Pacometer, eddy current scanners, low power radar, magnetic imaging shall be used as shown in Fig. 10. for floor areas where equipment is to be located. Indicate rebar location with colored removable marks on floor surface. The scanning function shall be performed by the equipment installation contractor or subcontracted by the installation contractor.

4.05 All drilling operations shall be accompanied with procedures for concrete dust removal. Dust removal systems shall be equipped with filter designed for collecting fine concrete dust. Contractor shall assure dust does not escape into equipment room through exhaust of the dust removal system.

4.06 Measure and mark floor for equipment base locations prior to drilling anchor holes. Verify equipment location will not be obstructed by floor openings, floor discontinuities, joints, or floor uneveness. If floor has been scanned for embedded rebar verify that anchor locations are away from suspected rebar. Use alternate anchor locations where rebar interference is found.

4.07 Drilled holes shall be at right angle to floor with vertical variance no greater than 10 degrees. Holes exceeding permitted deviation shall be abandoned and new hole located.

B. Hammer Drill

4.08 Hole depth shall be controlled by depth gauge on hammer drill unit. Hole shall never be drilled beyond anchor depth.

4.09 Drill anchor holes in concrete floors with a hammer drill and masonry bit. The hammer drill shall be the primary tool used on floor, wall or ceilings for concrete drilling requirements.

4.10 Concrete dust shall not be permitted to become airborne or collect in equipment area. A dust removal system shall be used with hammer drill to remove dust.

4.11 Hammer drill motors shall not emit EMI interference to affect network equipment operation. Drills used in the equipment building shall be manufactured in conformance to industry recommended standards for EMI interference limits.

C. Core Drill

4.12 Core drilling equipment may only be used with the approval of the Equipment Engineer, Real Estate Facilities Engineer and the local supervisor subject to the following operating restrictions to prevent water leaks and inadvertent rebar cutting.

4.13 Core drill equipment shall be used where vibration may be a problem, where more precise cuts are necessary or where embedded interference prevents hammer drill use.

4.14 All installation personnel using core drilling rigs in telephone company buildings shall be trained and certified. A certificate shall be issued by a recognized training organization such as Hilti or contractor's in-house training department certifying training and understanding of drill use. Operators shall have the certificate in their possession to be available when requested.

4.15 The core drilling rig shall be accompanied by a water recovery system with greater recovery capacity than water usage. The recovery system nozzle must be placed where the majority of water can be recovered. The water injection system shall not contain more than one gallon of water at any time. A water boot assembly shall be used around the core drill bit to contain water and to aid recovery. The boot shall be connected to the water recovery system.

4.16 Water flow rate shall be valve regulated to assure no more water than necessary is used. Pooling of water around drill bit and in hole shall never be permitted.

4.17 The core drilling rig shall be equipped with a depth indicator for drill bit depth in concrete. The indicator shall be set for the desired depth of the hole with a stop to prevent hole depth beyond limit.

4.18 While operating core drilling rig, any abnormal operation such as slowing of drill or excessive vibration or change in sound, the operator shall stop the drill to investigate cause. Resume operation only after investigation reveals no abnormal conditions.

D. Overhead Drilling

4.19 Holes for ceiling anchors are drilled similar to floor anchors. The same precautions and procedures for floor anchors shall apply when drilling overhead. When network equipment is located in area below, the equipment shall be covered with static-resistant tarps and plywood sheets to assure dust and tools/hardware do not fall onto equipment.

4.20 Drill may be difficult to handle when used overhead. If drill exceeds 25 pounds, ceiling attachment or floor support attachment must be used to support drill. High lift platform or temporary scaffolding is recommended for drill operator to stand on when drilling overhead. Drill operators shall not stand on A-frame ladders when operating drill overhead.

4.21 Do not drill overhead with water lubricated core drill unit when network equipment is located directly beneath area to be drilled. Core drill is permitted over network equipment only if operated without water lubrication.

5. ANCHOR REQUIREMENTS

A. Performance

5.01 Anchor performance is affected by concrete strength, anchor diameter, embedment depth, anchor spacing and anchor edge distance from concrete edge. Anchors must be installed in accordance to manufacturer's requirements.

5.02 To assure anchors resist lateral and tensile loads of equipment frameworks, preload of anchor hardware to anchor manufacturer requirements must be accomplished. Preload is applied by tightening anchor hardware to recommended installation torque values.

5.03 Telephone company approved anchors shall be used for securing network equipment to building. Anchors specified by telephone company have been tested and verified for performance. Alternative anchoring products are not permitted without written approval from company Seismic Protection Engineer.

B. Mechanical Anchor Types

5.04 Approved anchors for securing network products in equipment buildings are listed in Table 5.1 and as shown in Fig. 12.

Table 5.1
APPROVED ANCHOR TYPES (1)

ANCHOR	*SIZE*	*PID*	*HILTI P/N*	*APPLICATIONS*
Hilti HSL M12/25	12 mm	000325654	000665927	Capscrew version for **High Seismic Risk** sites with up to 1 inch base stackup, unequal flange frames, channel frames.
Hilti HSLB M12/6	12 mm	000203109	000457069 Hendry P/N H10255-006B	Short Torque Cap anchor for **High Seismic Risk** sites with up to 1/4 inch base stackup, unequal flange frames or channel frames and no base washers or isolators.
Hilti HSLB M12/25	12 mm	000203117	000674002 Hendry P/N H10255-001	Long Torque Cap anchor for **High Seismic Risk** sites up to 1 inch hardware stackup around base, unequal flange frames and channel frames.
Hilti HSLG M12/0	12 mm	000325670	000326520	Stud anchor insert for **High Seismic Risk** sites with no above ground hardware provided.
Hilti HSLG M12/25	12 mm	000203232	000684399 Hendry P/N H10255-003	Stud anchor with nut/stud for **High Seismic Risk** sites up to 1 inch hardware stackup around base, unequal flange and channel frames.
Hilti HSLG TN M12/0	12 mm		002172179	Short Torque Nut anchor for **High Seismic Risk** sites up to 1/4 inch hardware stackup around base.
Hilti HSLG TN M12/0	12 mm		002172161 Hendry P/N H10255-008	Torque Nut anchor for **High Seismic Risk** sites for 5ESS, network bay frame and equipment with up to1-1/4 inch base hardware stackup.
Hilti HSLI M12	12 mm		002171742	Female thread anchor for **High Seismic Risk** sites in low base clearance, network bay frames.
Hilti HSLB M16/6	16 mm	000325688	000457077	Short Torque cap anchor for **High Seismic Risk** sites in power equipment, battery stands with up to 1/4 inch base hardware stackup.
Hilti HSLB M16/25	16 mm	000203038	000674028	Long Torque cap anchor for **High Seismic Risk** sites in power equipment, battery stands with up to 1 inch base hardware stackup.
Hilti HDI 12	1/2 inch	000203026	000457549	Medium duty drop in anchor insert for **Low Seismic Risk** sites in network equipment and **all Zones** for raised floor equipment securing rods, data cabinets, storage cabinets.
Hilti HDI 58	5/8 inch	000210971	000457556	Medium duty drop in anchor insert for **all Zones** for ceiling hangers.
Hilti Kwik Bolt II 38-214	3/8 inch		000453621	Medium duty stud anchor for **Low Seismic Risk** sites for network equipment and **all Zones** for pipe stands, raised floor pedestals.
Hilti Kwik Bolt II 14	1/4 inch		000453605	Medium duty stud anchor for **Low Seismic Risk** sites for network equipment and **all Zone** floor system.

(1) *Anchors of various diameter, varying lengths and hardware options are available from manufacturer for all these anchor types when required for specific applications. Consult with Hilti Sales Engineer or Pacific Bell Seismic Protection Engineer.*

5.05 Embedded anchors shall be chosen for expected equipment frame loads and site conditions. Table 5.1 lists typical applications for each type of anchor for common equipment types. Anchors for applications not listed shall be chosen from applications of similar frame loads, i.e. equipment height, weight, base dimensions.

5.06 The load bearing capacity of the concrete floor is influenced by anchor spacing and anchor distance to edge. Anchors must be installed with minimum spacing maintained between anchors and distance of anchors from floor edge must be maintained as stated in Table 5.2 and shown in Fig. 11..

5.07 Anchor embedment depth must be maintained to achieve desired anchor performance. Anchor length considerations must include anchor hardware length above floor surface for equipment base thickness, shim height, isolation bushings, spreader plates, washers and hex nut as well as embedded depth as shown in Fig. 13. Improper calculation of above surface base hardware thickness may result in reduced embedment depth.

5.08 Anchor type and size shall be chosen with building floor thickness considered. Shallow floors may not permit installation of longer anchors. Increased quantities of smaller diameter anchors with their shorter embedment requirements may be substituted for the normal anchor as an alternative.

Table 5.2
ANCHOR INSTALLATION REQUIREMENTS

Anchor	HSL M12/6	HSL M16/6	HDI 3/8	HDI 1/2	HDI 5/8	Kwik Bolt 1/4	Kwik Bolt 3/8
Hilti Part Number	000457069	000457077	000457531	000457549	000457556	000453605	000453621
Drill bit diameter	18 mm.	24 mm.	1/2 “	5/8”	27/32”	1/4”	3/8”
Hole Depth	80 mm. (3.16”)	105 mm. (4.13”)	1-9/16”	2”	2-9/16”	1-1/8” min.	1-5/8” min.
Anchor Bolt Diameter	12 mm. (0.47”)	16 mm. (0.63”)	3/8”	1/2”	5/8”	1/4” nut	3/8” nut
Minimum spacing between anchor(1)	80 mm. (3.16”)	105 mm. (4.13”)	3-1/8”	4”	5”	1-1/8”	1-5/8”
Minimum edge distance (2)	80 mm. (3.16”)	105 mm. (4.13”)	3”	4-3/4”	6”	1-1/8”	1-5/8”
Installation torque (Max.)	60 ft. lbs.	105 ft. lbs.	11 ft. lbs.	22 ft. lbs.	37 ft. lbs.	4 ft. lbs.	20 ft. lbs.
Wrench size (Torque Cap)	24 mm.	30 mm.					
Wrench size (Hex Head)	19 mm.	24 mm.	9/16”	3/4”		7/16”	9/16”
Allowable Work Load (3000 psi concrete) Tension (Pounds)	3161	5416	1015	1345	1905	330	650
Shear (Pounds)	5387	9367	1025	1515	4100	430	1040

(1) *Spacing is the minimum centerline distance required between adjacent anchors. Anchors installed too close together will have reduced strength due to overstress of concrete.*

(2) *Anchors placed too close to free edge of concrete will cause rupture of the concrete. Anchor distance is measured from concrete edge to centerline of anchor hole.*

5.09 Powder actuated anchors shall never be used for securing network equipment or to brace network equipment. Powder actuated anchors are not be used for securing electrical conduit, pipes, wall brace, plywood sheets in network equipment areas. In non-network equipment areas of the building, powder actuated may be used. Prior to use of powder actuated anchor guns, occupants in adjoining rooms or adjacent floors shall be notified of its use.

C. Epoxy Anchors

5.10 Epoxy anchors shall only be used when mechanical anchors cannot be applied. Epoxy anchors shall be used where concrete problems arise or anchor holes have been improperly drilled. Epoxy anchors shall also be used where voids exist under floor or in hollow concrete walls.

5.11 Epoxy anchors function by bonding steel threaded rods or female threaded inserts to concrete with an epoxy adhesive. The epoxy bond applies anchor stress to a larger surface of the hole and fills voids permitting some equipment installations to be achieved in floor areas otherwise not suitable.

5.12 For concrete floors or walls with hollow space under surface, epoxy anchors are used as a keying anchor. The epoxy anchor resists pullout due to cured expanded adhesive on the backside of the concrete. A screen tube may be used with an internal threaded insert bonded to concrete to provide a female threaded anchor where desired.

5.13 Epoxy anchors shall only be used when approved by the Central Office Equipment Engineer and Seismic Protection Engineer with the following precautions:

A. The hole must be brushed and all traces of dust must be removed before applying epoxy adhesive.
B. Two part adhesive must be mixed in proper proportion and thoroughly mixed to achieve bonding strength.
C. Epoxy adhesive must be used within 30 minutes or adhesive will set.
D. Proper room temperatures must exist to allow curing of adhesive.
E. Anchors shall not be used for at least two hours to allow for curing. Anchors shall not be moved or tensioned during epoxy curing.

Table 5.3
EPOXY ANCHORS

Anchor Type	Size	Drill Dia.	Depth	Hilti Part Number
Hilti HIT C-100 with 1/2" diameter steel threaded rod for concrete floor	1/2"	9/16"	4-1/4"	Epoxy-HIT C-100 000680660 Threaded Rod HAS 1/2" Rod
Hilti HIT C-100 with internally threaded insert for concrete floor	1/2"	11/16"	4-1/4"	Epoxy-HIT C-100 000680660 Threaded Insert HFA 1/2" Insert
Hilti HIT C-20 with screen tube for hollow block/hollow floor	1/2"	27/32"	Through surface	Epoxy-HIT C-20 000680132 Screen Tube-HIT S-22/2 000778118 Rod/Insert HIT 1/2" 000883991

D. Wood Lag Screws

5.14 Equipment frames shall be secured to wooden floors with 1/2 inch diameter hex head lag screws. Lag screw length shall be chosen for deepest penetration into wood floor or joists.

5.15 Whenever possible the lag screw should be secured to floor joist. Position equipment frame for anchor locations over floor joists, when possible.

E. Through Bolting

5.16 Upper story concrete floors that are very shallow in depth or of questionable strength may not be suitable for normal mechanical anchor installation. Equipment frameworks may require alternative securing methods to work with non standard concrete floors. Through bolts can be applied to secure equipment when concrete floor performance is of concern.

5.17 Through bolts secure the equipment frame by extending through the floor and securing equipment with a nut and washer from the underside of the floor. Floor depth and concrete strength does not affect through bolt performance. The installation of through bolts requires hardware placement to floor as shown in Fig. 15.

5.18 The parts required for through bolt are 1/2 inch diameter Grade 5 capscrew, hex nut, large diameter thick washer or 1/4 inch thick steel plate. The capscrew head shall be tack welded or otherwise secured to the 1/4” thick steel plate. The plate shall be anchored in place with at least one 1/4” Kwik Bolt II anchor to keep through bolt in hole.

F. Surface Mount Channel

5.19 Where embedded concrete anchors are not desired or installation is difficult surface mounted channels are installed as anchor points. Surface mounted channels are typically used on ceilings to provide anchoring for suspended hanger rods or on floor for anchorage to toggle bars for equipment on raised floor systems.

5.20 Surface mount channels shall be Unistrut P1000 or equivalent 0.109 inch thick steel open channel. The channel shall fasten to concrete surface with U-shaped fitting, Unistrut P/N P1047 or equal, at minimum 24 inch spacing similar to Fig. 16. U-fittings are secured to concrete with two 3/8 inch Hilti HDI anchors. Free ends of channels must be supported by U-fittings to building at distance no greater than 6 inches from ends.

5.21 Surface mounted channels of longer runs shall be spliced with detail Unistrut P/N P2900, In Channel Joiner. Channels shall be supported at splice joint with Unistrut P/N P1047, U-Shaped Fitting, to building as shown in Fig. 17.

G. Anchor Installation

5.22 Basic anchor installation procedures:

A. Adjust depth gauge on hammer drill or core drill
B. Drill hole to recommended depth using correct diameter bit.
C. Clean hole with blowout bulb and vacuum.
D. Use hammer and tap anchor into hole.
E. Set anchor hammering set tool in anchor or tighten anchor fastener to set anchor.
F. Move network equipment into place and secure with anchor hardware to proper preload torque.
G. Anchors with stud and hex nut should have approximately 1 to 3 threads of stud exposed above top nut face following final tightening.

5.23 For specific anchors the basic installation instructions are modified with the following steps.

HSL Style Anchors
Following Step C. move equipment frame over drilled hole before placing anchor into hole. Tap anchor through equipment base into hole in floor. Some frames require anchors to be installed in floor initially with anchor set. Remove anchor hardware and move equipment frame over anchors then replace anchor hardware. Tighten anchor fastener to recommended torque value. Some HSL anchors have break off hardware that shear when proper preload torque is achieved. ***Beware of sudden release of head***. Make sure fingers are clear of base when tightening. A long breaker bar over wrench handle will reduce risk of injury.

HDI Style Anchor
Hole depth must be kept within manufacturer recommended depth. At Step E. use manufacturer provided setting tool only. Hammer setting tool on anchor until anchor is seated. Move equipment over anchor. Place fastener through equipment base into anchor and tighten fastener to recommended torque value. Anchors used for threaded rods should have rod at least 2/3 into anchor. Do not exceed tightening torque.

Kwik Bolt II Style Anchor
Following Step C. move equipment frame over drilled hole before placing anchor into hole. Tap anchor through equipment base into hole in floor. Tighten nut to recommended torque.

5.24 Anchors that are available with torque indicating hardware or break off torque hardware shall be used. Tamper indicators provided with torque indicating hardware shall not be removed. Anchors not available with torque indicating hardware shall be tightened with torque wrench to recommended preload torque with preload subject to verification by telephone company engineer. Installation will be acceptable if values are within 75 percent of recommended preload torque when verified by inspector.

6. ANCHOR INSTALLATION PROBLEMS

A. Reinforcing Bar Interference

6.01 Embedded rebar in the path of the drill bit will prevent the hole from achieving desired depth as shown in Fig. 18. Hole depth will be restricted to top of rebar.

6.02 Embedded rebar shall never be cut or bored without permission from company Real Estate Facility Engineer or by an authorized company Engineering Representative.

6.03 Reinforcing steel will typically be 5/8 inch diameter steel rods placed in common axes to building walls. Rebar is placed approximately 6 inches apart. Near building columns, against structural walls and along floor beams a much higher density of rebar can be expected. Rebar size and layout pattern can vary greatly depending on specific structural engineering requirements and building construction.

6.04 Procedures for handling rebar interference are as follows:

A) Use alternate anchor hole location in equipment frame base. Frames may have second anchor hole location or slotted hole for moving anchor away from interfering rebar. A new hole is drilled away from interfering rebar.
B) Move frame 1 to 2 inch away from interfering rebar location. Redrill new anchor holes.
C) Check depth of hole where rebar interference is detected. If hole is 3 inches or deeper, the hole may be used for 12mm. anchors with minimal affects. A hole 2-1/2 inch to 3 inches deep can be used as is if all other anchors of this frame are at proper depths. Hole with rebar interference less than 2-1/2 inch depth cannot be used.

D) Provide external anchor positioning for frame by attaching steel angle to equipment base or provide anchor location away from obstructed area. External angle shall not protrude more than 3 inches from frame base. 3/8 inch diameter Grade 5 capscrews at 8 inch centers is recommended to attach angle to equipment base.
E) An anchor may be deleted under following circumstances. For obstructed hole not at corner or perimeter of base, one inboard anchor may be eliminated if all other anchors are properly installed. Obstructed hole of mid lineup frame, with adjacent frames properly anchored and junctioned, one anchor may be eliminated including a corner anchor. If more than one anchor is affected contact company Seismic Protection Engineer.
F) Rebar is cut by core drill bit at interfering location. Cutting of rebar is never permitted without permission from company Real Estate Site Engineer. Cutting of rebar will never be permitted in crucial areas of a building, i.e. between building column line, near floor openings, near load bearing walls.

6.05 An equipment frame with anchor hole interference at more than one location follows Paragraph 6.04 recommendations with following exceptions:

A) Two anchors at 2-1/2 inch or deeper is permitted for mid lineup frames when all adjacent frames are properly anchored and junctioned.
B) Only one anchor may be deleted within a frame under guidelines in paragraph 6.04.
C) If cutting rebar has been determined as solution, multiple anchors may be affected by a common rebar. If the rebar will be cut, additional cuts into the same rebar is permitted.

B. Shallow Concrete Floor

6.06 Concrete floors less than 5 inch deep may pose problems for installation of embedded anchors. The thin floor may not be deep enough for longer anchors to be installed. The thin floor may spall on the underside of hole. For slab on grade floors, drilled hole may open the floor for water to penetrate into the equipment area.

6.07 When using hammer drill in thin floors, drill normally to within last inch. For the last inch of depth, stop the hammering mode and drill using rotary action only for remaining depth. Use the depth gauge on the hammer drill to limit hole depth to what is required for anchor.

6.08 Core drilling is recommended when boring in thin concrete floors. Core drills have smoother cutting action and can be more precisely controlled for depth. The smoother operation reduces dangers of fracturing concrete when approaching thin bottom layer.

6.09 Insert anchors into hole with very light taps. Do not use hammer to force anchor in drilled hole. When approaching bottom of hole, be especially careful not to tap anchor when anchor is bottomed in hole.

6.10 Concrete floors where bottom of hole has spalled or where floor depth is 3-1/2 inches or less requires alternative equipment securing methods.

A) Secure equipment frame to floor with through bolts.
B) Secure equipment frames with epoxy anchor.
C) Reduce mechanical anchor depth with permission from company Seismic Protection Engineer.

6.11 For slab on grade construction, anchor holes that have penetrated through slab must be filled with water sealant prior to installation of mechanical anchor. Silicone type sealant equal to bathtub caulking shall be injected into bottom 1 inch of hole. Tap anchor into hole before sealant cures.

6.12 Slab on grade floors with underside spalled or where slab depth is 3-1/2 inches or less, use an epoxy anchor with screen and internal thread insert as shown in Fig. 19. Epoxy anchored equipment will not require water sealant.

C. Poor Concrete Quality

6.13 Poor concrete quality will be obvious while drilling hole. Drill will penetrate concrete with very little resistance and walls of hole may crumble or break up into fine dust. Hole diameter may not be maintained due to wall pulverization. Aggregate may not be visible in the concrete mix.

6.14 Non-structural concrete may be used as a filler floor layer poured over structural concrete. This layer should not be used for securing anchors. Drill through the filler layer at minimum 2 inches into the structural concrete to secure anchors. Replace anchor bolt with longer bolt to extend down to new depth.

6.15 Poor quality concrete requires anchor pullout tests be performed to verify anchor strength. Pullout tests on anchors will determine if special anchoring procedures will be necessary. After installing three anchors at 12 inch spacing in suspect floor, apply 75 percent of ultimate tensile load on each anchor. If concrete fails before 75 percent load is reached, mechanical anchors should not be used. Epoxy anchors or through bolts to building floor may be required to secure equipment in poor quality concrete. Similar pullout tests on cured epoxy anchors should be conducted before use.

D. Embedded Cable Duct/Conduit

6.16 Floors constructed with ducts or conduit embedded in the concrete can interfere with placement of floor anchors when equipment is located over ducts/conduits. Ducts may be open at the surface with a steel plate cover or completely embedded with access openings every few feet.

6.17 Locating equipment frames directly over cable duct openings should be avoided. Surface plate will not support weight of equipment frame. Deflection of plate may result in equipment frame instability. Electrical isolation of equipment frame is made more difficult when placed over duct cover.

6.18 Equipment that must be placed over embedded duct/conduit shall straddle the duct/conduit area as shown in Fig. 20A and 20B. A 1/2 inch thick steel plate shall be secured to floor with Hilti HSLB M12/6 anchors 2-3 inches out from original anchor locations. Counterbored anchor holes in steel plate minimizes bolt head protrusion of floor anchors. Drill and tap 1/2-13 holes in the steel plate to match equipment frame anchor hole locations. Isolation pads under equipment frame and isolation bushings at equipment frame anchors shall be used if isolation is required.

6.19 Embedded duct/conduit shall never be purposely cut or drilled. Live power cables may be housed within duct/conduit.

6.20 Embedded water pipe or gas pipe may be found in some building floors. When pipes are accidentally hit with drill bit, stop activity in that area. Investigate for leakage of water or gas. If leakage is found, advise the office manager immediately.

6.21 The equipment frame should be moved away from area where pipes are located and anchor locations moved to avoid pipes. Do not bore into pipe even if dry. Anchors cannot secure properly to floor voids created by pipe.

6.22 Surface mounted utilities may be installed on underside of floor. Check for pipes and conduit surface mounted to ceiling on lower floor before drilling operation. Avoid drilling through floor by using depth gauge on drilling tool.

E. Oversize Holes

6.23 Holes misdrilled more than 1/8 inch over anchor manufacturer's recommended diameter or where hole in concrete is breaking or pulverized shall not be used. Expansion sleeve anchors cannot set properly in oversized hole. The anchor is to be relocated, replaced with larger diameter anchor, or hole filled and redrilled.

6.24 Holes to be redrilled for next size anchor shall be redrilled with core drill to proper diameter. Hammer drill should not be used for redrilling hole.

6.25 Holes to be filled shall be repaired with approved mortar material specified in Paragraph 9.08. After mortar has properly cured, the mortar can be redrilled to depth and size required for embedded anchor.

F. Floor Level Compensation

6.26 Floors not within acceptable tolerance for level and flatness may result in alignment difficulties between equipment frames. Floor uneveness is corrected by placing shims under equipment base. For greater floor variations reconditioning of floor may be required.

6.27 Shims shall be manufactured of steel or high density, non flammable polymeric materials. Shim material shall not change in shape or size with preload force of anchors or weight of equipment. Shim shall be shaped for insertion under equipment base at anchor locations. Each shim shall be of a dimension to support at least 10 percent of base area.

6.28 Shims exceeding 1 inch height shall be one piece or stacked shims bonded together by tack welding or epoxied between shims. If isolation shim is used under or over height adjusting shims for 1 inch or over stack, the isolation shim shall be bonded by adhesive to other shims.

6.29 Anchor hardware shall be replaced with longer bolt or stud for the added height of the shim stack. Embedment depth of the anchor remains as recommended by anchor manufacturer. Standard anchor hardware has margin for shim heights of only 1/8 to 1/4 inch.

G. Moisture and Corrosion

6.30 In adverse environments stainless steel anchor hardware may be required. Standard anchor hardware typically is zinc plated steel, adequate for most network equipment environments. Battery stand anchors do not require stainless hardware unless anchors are continuously wetted down with liquid electrolyte.

6.31 Embedded expansion sleeves will reveal some signs of corrosion under normal conditions. Surface corrosion will not affect performance unless expansion sleeve or wedge has deteriorated. Water seepage penetrating through slabs on grade may subject anchors to continuous moisture. In areas with high salts or contaminants in the soil, seeping water may result in more rapid deterioration of anchors. Stainless steel anchors should be used in more severe environments.

6.32 Anchors specified in Table 5.1 will provide adequate service for the life of network equipment under normal conditions.

6.33 Anchors subject to liquid intrusion from above or below shall be sealed against leaks with silicone sealant. These procedures will meet battery room floor containment requirements **.** Prior to insertion of anchor into drilled hole, apply silicone sealant such as bathtub caulking into hole 1/3 full. Tap anchor into sealant and tighten to recommended torque. For sealing against liquid intrusion from above, finish sealing by applying bead of silicone sealant around anchor washer and around hex head nut or capscrew.

7. ANCHOR MAINTENANCE

A. Anchor Maintenance

7.01 For normal service in central offices, data centers or customer premise locations, equipment anchors do not require periodic maintenance. Unless equipment frames have been stressed by accidental impact or building motions, embedded anchors should continue to provide adequate performance even after many years of service.

7.02 Obvious signs that anchors may need attention:

- Movement of frame base, either rocking or sliding with slight hand pressure.
- Upward bulging of floor tile under equipment frame.
- Loose anchor hardware.

7.03 Following major earthquakes, equipment buildings within 50 mile radius of the epicenter may experience severe displacement and ground accelerations. Equipment floor anchors may have been overly stressed. Anchor inspections are recommended in the immediate epicentral area and up to 50 mile radius. Inspections are especially important for equipment installed prior to the year 1989.

7.04 Equipment buildings that have experienced continuous vibrational disturbances as result of construction, demolition, unbalanced building services equipment may require an anchor inspection to assure they have not loosened.

7.05 Anchor performance is affected by hardware preload, concrete integrity and initial installation procedures. Loose anchor fasteners or broken anchors should be tightened or replaced immediately.

7.06 Before proceeding with any maintenance procedures, the type of anchor to be serviced must be determined. Anchors have design differences and inspections may reveal conditions that may be regarded as failure for one type while being acceptable for another.

B. Historical Applications

7.07 Prior to 1971, the most commonly used floor anchors were Loxin zinc alloy anchors of very limited strength. In the 1970's the Phillips self drilling anchors were introduced which increased pull out strength. In the late 1980's the Hilti HSL was introduced for even greater pull out strength. A variety of other floor and ceiling anchors have been installed in equipment buildings.

Table 7.1
COMMON NETWORK EQUIPMENT ANCHOR STYLES

Anchor Type (Most Commonly Used by AT&T, NTI Equipment Installation)	**Depth** (Typical)	**Material**
Loxin Expansion Shield 3/8"	2"	Zinc/lead alloy
Phillips Self Drilling 1/2"	2"	Steel
Hilti HSL 12mm	3-1/4"	Steel
Hilti HSL 16mm	4-1/4"	Steel
Hilti HDI Drop In 1/2"	2"	Steel

Table 7.2
COMMON BUILDING EQUIPMENT ANCHOR (1)

Anchor Type	**Depth** (Typical)	**Material**
Kohler cast in place ceiling 5/8"	3-1/2"	Cast Iron
Hilti HDI Drop In 5/8"	2-9/16"	Steel
Star Expansion shield 5/8"	2-1/2"	Zinc/lead alloy
Hilti Powder Actuated .145, .177, 1/4", 3/8"	5/8" to 1-1/2"	Steel

(1) These anchors will be used with ceiling hanger rods or to secure building air conditioning, fans, chillers, service transformers, AC service panels, conduit, water pipe, etc.

7.08 Identifying anchor type may be difficult since anchors are embedded in the concrete. Identifying marks are not visible or anchors may be covered with debris or floor tiles. The equipment vintage and technology may indicate anchor type. Table 7.3 lists anchor usage by technology types.

7.09 The anchor types listed in Table 7.3 are anchors specified by the manufacturer at time of installation. Substituted anchors by installation contractors may not be listed in this table.

C. Anchor Inspection and Retightening

7.10 The procedure for inspecting anchors will vary in accordance to anchor style. Inspection parameters for all anchors should include observing for:

1. Fastener looseness
2. Concrete failure in immediate area surrounding anchor
3. Missing anchor hardware
4. Broken or bent anchor hardware

Table 7.3
NETWORK EQUIPMENT APPLICATIONS

Equipment	Version	Anchor Type (Typically used)
AT&T 1/1A ESS	Up to about 1971	Loxin zinc alloy 3/8"
"	1971 on	Phillips self drilling 1/2"
NTI DMS-100/200	Up to about 1985	Hilti HSL 12mm stud
"	1985 on	Hilti HSL 12mm/16mm
AT&T 5ESS	Up to about 1988	Phillips self drilling 1/2"
"	1988 on	Hilti HSL 12mm stud
9'-0" - 11'-6" Duct Frame	All	Loxin zinc alloy 3/8"
9'-0" - 11'-6" Channel frame	Up to 1975	Loxin zinc alloy 3/8"
"	1975 on	Phillips self drilling 1/2"
9'-0" - 11'-6" Unequal flange frame	Up to 1989	Phillips self drilling 1/2"
"	1989 on	Hilti HSL 12mm
7'-0" Unequal flange frame	Up to 1989	Phillips self drilling 1/2"
"	1989 on	Hilti HSL 12mm
Conventional MDF	Up to 1975	Loxin zinc alloy 3/8"
Conventional MDF	1975 on	Phillips self drilling 1/2"
Modular MDF	Up to 1989	Phillips self drilling 1/2"
"	1989 on	Hilti HSL 10mm
Power Products cabinets, channel frames	Up to 1975	Loxin zinc alloy 3/8"
"	1975 to 1989	Phillips self drilling 1/2"
"	1989 on	Hilti HSL 12mm
Battery Stand Western Electric	Up to 1975	Loxin zinc alloy 3/8"
"	1975 on	Phillips self drilling 1/2"
Battery racks free standing, rectifiers	All	Hilti HSL 16mm

7.11 Inspection of anchors requires access to anchors. Many anchors are hidden behind covers, under frame base or access blocked by installed equipment. Removal of covers should be performed only by qualified personnel to minimize service risks. Some equipment may have devices installed under covers. Condition of inaccessible anchors may have to be determined by condition of other anchors in adjacent equipment or observing other problem signs.

7.12 All anchors will have test values lower than preload tensions achieved when anchors were initially installed. The preload tension relaxes immediately following installation due to anchor creep, movement of base and compression of material under base. Over many years the preload tension relaxes further. Retighten anchors to retorque range in Table 7.4 during inspection process, *do not tighten to original new installation torques.*

Table 7.4
RECOMMENDED RETORQUE VALUE

Anchor Style	Mfr. recommended new installation torque	Recommended retorque range following inspection
Loxin zinc alloy anchors, 3/8" dia.	10-15 ft. lbs.	5-15 ft. lbs.
Phillips self drilling, 1/2" dia.	20-25 ft. lbs.	10-20 ft. lbs.
Hilti HSL, 12 mm. dia.	55-60 ft. lbs.	25-35 ft. lbs.
Hilti HSL, 16 mm. dia.	140-150 ft. lbs.	80-100 ft. lbs.

7.13 Inspection procedures should include looking for loose anchor hardware, measuring torque of anchor hardware, looking for concrete condition in areas surrounding anchors. Tools required to perform inspections are:

- 1/2 inch torque wrench with scale 0 to 100 foot pounds minimum
- various metric and SAE sized sockets
- linoleum tile removal blade
- flashlight
- flat and Phillips screwdriver

7.14 Anchor inspections should be conducted on a sampled basis initially to determine if further inspections are necessary. Choosing equipment frames most likely to experience anchor stress will reduce number of frames needed to be inspected. Sampled frames should be chosen by following criteria:

1. The most heavily loaded frames, i.e. those housing power equipment, tape drives, fully loaded card cages, etc.
2. Frame located at the end of the lineup, along aisles. These frames do not share load with adjacent frames.
3. Stand alone frames that do not junction to adjacent frames.
4. Frames that appear to be leaning or not standing straight.
5. Cracks on the floor or bulging of concrete under frame.
6. Frame that rocks or moves when applying slight pressure on frame.
7. Critical equipment frames, i.e. processors, power distribution bays.

7.15 Two frames of each lineup of equipment are recommended to be inspected initially. Based on results of these two frames, additional inspections may not be necessary if results of these anchors are satisfactory.

7.16 Inspection acceptance criteria is reflected in Table 7.5 through 7.8 for most common anchor styles. Other anchor types shall follow procedures for Phillips Self Drilling anchor.

7.17 Results of sampled frames shall determine if anchors in additional frames and lineups are to be inspected. Site conditions, proximity to earthquake epicenter may dictate closer inspection of all equipment. More recent technologies using Hilti HSL type anchors are less prone to anchor stress than older anchor types.

Table 7.5
INSPECTION CRITERIA LOXIN

Anchor Style	Findings	Remedial Procedure
Loxin zinc alloy 3/8”	Anchor nut torque 5 ft. lbs. or greater, nut is tight against frame base	Anchor is satisfactory, tighten to recommended retorque value, Table 7.4
“	Torque value of nut below 5 ft. lbs.	Inspect other anchors in frame. If more than two anchors found in similar condition, inspect all anchors in lineup. If not, tighten this nut to retorque value, Table 7.4
“	Nut is obviously loose with play between nut and base	Inspect for concrete spalling under anchor. If anchor has not failed, retorque and check other anchors in frame. If anchor has failed, repair or replace.
“	Nut will not retighten, preload cannot be achieved, anchor appears to be withdrawing from concrete	Anchor has failed and is pulling out of floor. Inspect other anchors in this frame. Repair or replace.

Table 7.6
INSPECTION CRITERIA PHILLIPS

Anchor Style	Findings	Remedial Procedure
Phillips Self Drilling 1/2”	Anchor nut torque 5 ft. lbs. or greater, nut is tight against frame base.	Anchor is satisfactory, tighten to recommended retorque value, Table 7.4
“	Torque value of nut below 5 ft. lbs.	Inspect other anchors in frame. If more than two anchors found in similar condition, inspect all anchors in lineup. If not, tighten this nut to retorque value, Table 7.4
“	Nut is obviously loose with play between nut and base.	Inspect for concrete spalling under anchor. If anchor has not failed, retorque and check other anchors in frame. If anchor has failed, repair or replace.
“	Floor tile lifted or cracked concrete under anchor.	Inspect floor area under anchor for broken concrete. If concrete is broken, remove anchor and repair floor. Install new anchor.
“	Nut will not retighten, preload cannot be achieved, anchor appears to be withdrawing from concrete	Anchor has failed and is pulling out of floor. Inspect other anchors in this frame. Repair or replace.

7.18 Anchor inspections for questionable sites should be implemented as soon as possible due to possibility of damage resulting from after shock activity. Equipment anchors previously loosened or failed as result of earthquake may not provide adequate performance for future events.

Table 7.7
INSPECTION CRITERIA HILTI HSL 12 mm.

Anchor Style	Findings	Remedial Procedure
Hilti HSL 12 mm.	Anchor nut torque 15 ft. lbs. or greater, nut is tight against frame base	Anchor is satisfactory, tighten to recommended retorque value, Table 7.4
"	Torque value of nut below 15 ft. lbs.	Inspect other anchors in frame. If more than two anchors found in similar condition, inspect all anchors in adjacent frames initially. If more than 2 anchors loose in adjacent frames inspect all anchors of lineup. If not, tighten this nut to retorque value, Table 7.4
"	Nut is obviously loose with play between nut and base	Inspect for concrete spalling under anchor. If anchor has not failed, retorque and check other anchors in frame. If anchor has failed, repair or replace.
"	Nut will not retighten, preload cannot be achieved, anchor appears to be withdrawing from concrete	Anchor has failed and is pulling out of floor. Inspect other anchors in this frame. Repair or replace.
"	More than two failed anchors discovered in sampled frames.	Inspect all anchors of that lineup for other failures. Repair or replace.

Table 7.8
INSPECTION CRITERIA HILTI HSL 16 mm.

Anchor Style	Findings	Remedial Procedure
Hilti HSL 16 mm.	Anchor nut torque 25 ft. lbs. or greater, nut is tight against frame base	Anchor is satisfactory, tighten to recommended retorque value, Table 7.4
"	Torque value of nut below 25 ft. lbs.	Inspect other anchors in frame. If more than two anchors found in similar condition, inspect all anchors in adjacent frames initially. If more than 2 anchors loose in adjacent frames inspect all anchors of lineup. If not, tighten this nut to retorque value, Table 7.4
"	Nut is obviously loose with play between nut and base	Inspect for concrete spalling under anchor. If anchor has not failed, retorque and check other anchors in frame. If anchor has failed, repair or replace.
"	Nut will not retighten, preload cannot be achieved, anchor appears to be withdrawing from concrete	Anchor has failed and is pulling out of floor. Inspect other anchors in this frame. Repair or replace.
"	More than two failed anchors discovered in sampled frames.	Inspect all anchors of that lineup for other failures. Repair or replace.

D. Testing Anchors

7.19 Tests to determine anchor performance may be done at the jobsite. For purposes of network equipment securing, performing static tension tests would provide adequate indication of anchor performance. It is anticipated that concrete failure would occur before exceeding anchor hardware limits. Tests are typically performed when concrete conditions are questioned or if anchor manufacturer's installation procedures were not followed.

7.20 Equipment required for jobsite tests:

Hammer drill with bit (Required if anchors to be tested will be installed at time of tests)
Ratchet wrench with socket sized for anchor
Hydraulic ram with pump
Pressure gauge or load cell
Tripod or stand for ram
Adapting hardware to connect ram to anchor
Concrete epoxy repair mortar

7.21 When tests are performed on ceiling installed anchors, the hydraulic ram may be replaced with suspended weights. The weights shall be stacked close to floor by suspending a tension member, (i.e. wire rope, chain, threaded rod) down from anchor to floor level. Tension member must be rated for minimum 15,000 pounds tension.

7.22 For floor installed anchors, hydraulic ram used to pull on anchor shall be configured so reaction force back to floor will be away from concrete area surrounding the anchor. Ram tripod or stand must have base at least 12 inches in diameter.

7.23 Anchor shall be tested to 75 percent of ultimate value for anchors in 3000 psi concrete. (Ultimate values would be about 3-1/2 times allowable work load in Table 5.2) Tests to 75 percent value should avoid concrete spall yet achieve high enough value to verify strength of concrete. At least five anchors installed over 25 square feet should be tested for good sampling. After reaching 75 percent load, maintain load and visually verify on pressure gauge that tension does not rapidly decline.

7.24 Install anchors per manufacturer instructions, tighten anchor hardware to test equipment, apply load gradually with ram or by adding weight until reaching test value. Failure would be indicated by anchor pullout or concrete fractures and inability of anchor to carry additional load.

8. Removing Anchors

A. When Are Anchors Removed

8.01 An anchor may need to be removed when the anchor or concrete has failed; or anchors have been abandoned due to removal of equipment; or anchors obstruct other activities.

8.02 Abandoned anchors are removed only when:

A. The anchor protrudes above the floor surface presenting a tripping hazard for personnel/equipment or interferes with resurfacing of floor.
B. The anchor is located under a new equipment frame or cabinet and interferes with the installation of anchors for the new equipment.

8.03 Abandoned anchors normally shall be left in place and may be covered with floor covering if necessary. Mark surface of floor covering to indicate anchor location with an adhesive backed paper dot.

8.04 Anchor bolt holes left exposed in abandoned anchors are not required to be filled except under following conditions:

A. All holes equal to 1/2 inch diameter and greater in normal foot traffic path shall be filled and leveled to floor surface.

The site manager or central office equipment engineer shall determine where foot traffic may occur for the site. Floor markings may be necessary to control traffic through equipment areas. Red or yellow adhesive tape on the floor outlining the walk path where anchor hazards have been eliminated is recommended. The outlining measure should be applied when a vacant equipment area of three building bays or more exist and foot traffic off aisleways into equipment area is possible.

B. All anchor holes greater than 1/2 inch diameter, not including 1/2 inch, in any area of equipment building shall be filled and leveled to floor surface with non hardening materials specified in paragraph 9.11.

C. The surface concrete surrounding an anchor shall be repaired if found to be broken. The area shall be cleaned and inspected beyond surface damage. Concrete damage beyond 3/8 inch depth requires removal of anchor to fill hole and redrill for new anchor.

8.05 Before removing any embedded anchor, the removal contractor must determine the type of anchor in place. The anchor type determines removal methods to be applied. If the anchor type cannot be determined, the anchor shall be treated as a self drilling steel anchor.

8.06 Typically, zinc alloy or lead alloy anchors used smaller fastener sizes, 1/4" or 3/8". Alloy anchors are a softer material which can be nicked by a pocket knife. Steel anchors will less likely be nicked with a knife blade.

8.07 Anchor types not listed on the above tables shall be removed with method similar to *Phillips self drilling anchor*.

B. Removal Methods

8.08 Anchor Removal Procedures:

Loxin zinc alloy anchors
These anchors may be removed by pulling directly on the anchor with a hydraulic ram or other tensioning device that produces tension load no greater than 2000 pounds. Anchors that cannot be pulled at that force should not be extracted by this method. The puller base legs or ring must be at least 6 inches away from the anchor. Pulling forces will push against floor to prevent concrete spalling. Attachment to anchor may be with tapping lag bolt or threaded rod to body of anchor. Do not pull by applying tension load to wedge at bottom of anchor.

Phillips self drilling anchors
Anchors shall not be extracted by directly pulling on anchor. The force required to remove these anchors will cause concrete spalls or cracks. Do not attempt to loosen anchor by driving out wedge at bottom of the anchor. The self drilling anchor is initially set by hammering the wedge into the anchor. Therefore, attempts to knock wedge out further tightens anchor against hole. These anchors can only be removed by core drilling with a bit slightly larger in diameter than the anchor.

Hilti HSL anchors
These anchors shall not be extracted by pulling on anchor. The forces required to remove anchor will cause concrete spalling and cracking. Anchors are not required to be removed by design. The HSL anchor have a removable steel sleeve leaving no projection above floor. Only a hole would remain when sleeve is removed. If the remaining expansion sleeve must be removed, the following method has been found to be effective. The wedge at the bottom of the expansion sleeve should be driven out with a slight tap with a hammer and drift. Remove the plastic collar on top of expansion sleeve with a hooked wire. Thread a screw tap into the expansion sleeve and withdraw sleeve from hole. If anchor cannot be removed by this method, core drill to remove anchor.

8.09 Following the removal of anchors, the hole must be filled with approved repair material to bottom of hole and leveled to adjacent areas. Prior to applying repair materials, dust and dirt of hole must be removed and walls brushed for loose dust. Repair material specified in paragraph 9.08 shall be used for filling hole.

9. FLOOR REPAIR

A. General Requirements

9.01 Floor surface shall be free of hazards and ready for future equipment installation. Condition of floor should be flat, level and free of protruding obstructions. Restoration efforts shall be implemented to have floor brought up to these requirements following equipment removals.

9.02 Concrete floors and ceiling may be cracked, spalled or contain open holes. Concrete damage or holes can be result of removed equipment, anchor pullout, installation errors. Cracks may also develop from concrete shrinkage or floor stress. Cracks may be cosmetic or they may indicate structural distress. Consult with company Real Estate Facilities Engineer if there is suspicion of structural damage.

9.03 The repair procedures described within this document are intended to be carried out by equipment installation contractors. The repairs are surface restoration efforts and not structural repairs. Structural repairs are defined as work to load bearing members where repairs affect the integrity of the member.

B. Cracks In Concrete

9.04 Hairline fractures greater than 1/32 inch wide shall be repaired with crack injection epoxy prior to floor anchor installation. Cracks that exceed 1/8 inch width may signal overstress of concrete and could have an affect on embedded anchor performance if anchor is placed in crack. Cracks may widen or anchor may not wedge against walls adequately. Contact telephone company facilities engineer if cracks of 1/8 inch or greater are discovered.

9.05 Floor surfaces at a crack joint may be higher on one side of crack than other. Equipment frames straddling the crack shall be supported at the base with shims to level frame and elevate base above joint as shown in Fig. 21. Anchors shall be placed away from crack joint.

9.06 Floor sections at building joints or building additions may have uneven surfaces at floor joints. Equipment frame shall not straddle floor joints because of possible of floor joint movement that can result in misalignment of equipment frames. If equipment placement cannot be placed away from joint, straddled equipment shall be supported as described in Paragraph 9.05.

9.07 Concrete cracks up to 1/8 inch wide shall be repaired with crack injection epoxy products such as **Hilti EP IS 650 Crack Injection System**. Cracks of greater width requires structural engineer inspection and repair recommendation. Precautions shall be taken to prevent crack injection material from leaking onto equipment and floor below. Crack injection is light viscosity fluid designed to follow cracklines.

9.08 Level cracked joints with repair mortar material such as:

Hilti RM698 Epoxy Repair Mortar Available 22 lb. container. (Caution: This product contains materials that may emit objectionable odors. Proper eye and skin protection is recommended when using this product. At facilities where occupants are sensitive to odors, this product should be used with caution.)

Hilti RM700EP Epoxy Repair Mortar Available 9 lb. or 65 lb. container. (To be used where RM698 may be objectionable. Epoxy components are similar, but product formulated for use in sensitive environments.)

RM800PC Cement Repair Mortar Available 50 lb. container. (To be used where RM 698 may be objectionable. This product is cement based with latex polymer and all precautions normally taken with handling cement should be exercised.)

These recommended repair mortars are epoxy based or cement with latex polymer products that have been tested for bonding strength and material strength. Cement based only repair materials are not to be used because of unknown compressive strength and bonding characteristics. Feather repair material across crack areas beyond immediate crack to assure level surface for equipment base. Cracked concrete with uneven surface exceeding 3/16 inch may require grinding higher surface flush to opposing surface before final finishing with repair mortar.

9.09 Cracks in slabs on grade shall be repaired to prevent water penetration through cracks. A crack injection epoxy shall be used to repair small cracks and floor resealed following repairs.

C. Fill Holes

9.10 Holes in concrete floor/ceiling as result of core drilling for removal of abandoned anchors, for pipe or cables between floor/walls may create a large opening. Openings greater than 3 inches diameter are not covered by procedures within this document. These openings should be treated as cable holes and be sealed using cable hole opening procedures.

9.11 Abandoned anchors leave exposed a hole where anchoring hardware secured the equipment. The abandoned anchor holes shall be filled with removable filler material such as silicon caulking, bathtub sealer, or pliable clay to surface level of anchor. Future extraction of anchors from floor will be aided by using these non hardening fillers.

9.12 Fill holes in concrete with mortar materials recommended in Paragraph 9.08 only. Do not use products such as “Pour Stone”, “Fix -All” or other unevaluated cement based repair materials.

9.13 An anchor securing in service equipment shall be repaired by removal of the anchor, filling the hole with approved mortar material and redrilling the hole for a new anchor. The broken concrete around an anchor shall not be repaired by surface patching only.

9.14 Assure the hole is not open at the bottom of the concrete slab. The bottom of the hole must be plugged to prevent repair material from flowing through. If access is available from below, provide a board or plate secured to underside of floor. If bottom access is difficult, plug from above with stopper pushed through hole. The stopper depth should allow at least 3-1/2 inch of repair material to be poured over it. After cleaning hole of dust and dirt fill hole with repair material until flush with surface of floor.

D. Concrete Spalls

9.15 Spalls are fractures to concrete leaving deep pits in the concrete surface as shown in Fig. 24. Spalls are created by embedded anchor pulled out of floor or ceiling, or fractures to the concrete or hard impact on concrete. The concrete is typically fractured on the surface extending to several inches below the surface.

9.16 All loose cement and rock must be removed prior to repairs. Cracked concrete that has not broken away must be chipped loose until reaching good concrete. The broken concrete area may be as deep as 4 inches and 12 inches in diameter. Vacuum and brush surfaces to remove all loose dirt and dust before applying repair material.

9.17 Use repair material recommended in Paragraph 9.08 only. For RM800PC repair material the surface of the repair area must be dampened with water prior to application of mortar. Do not allow water puddling or flooding. Use a spray bottle to wet surface. Assure cracks do not open through slab and permit water to drip below.

9.18 Finish of repaired surface shall be level, flat and flush to adjacent floor area within 1/16 inch. If floor covering will be placed over concrete surface, assure repair area is at correct surface height of concrete and not result in elevated or bulged floor covering.

9.19 Repairs to ceiling must be temporarily supported with flat board to prevent patch material from pulling away from ceiling. Set time of repair products is about 30 minutes at about 70 degrees F..

E. Floor Surface Leveling

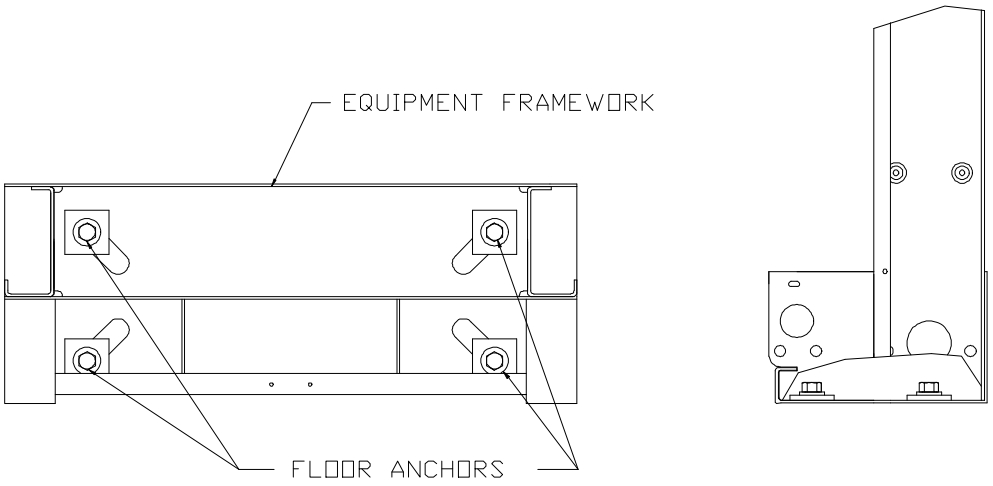
9.20 Floor surfaces when examined with a straight rule may indicate floor higher on one end as shown on Fig. 22 or have high and low points in immediate areas similar to Fig. 23. Company building specifications permit 1/8 inch slope across 10 feet. In extreme cases, these conditions can result in equipment frame installation difficulties. Corrective measures for floor surface conditions should be performed by the Real Estate Facilities Management organization when identified as requiring action.

9.21 Corrective actions that may be taken are:

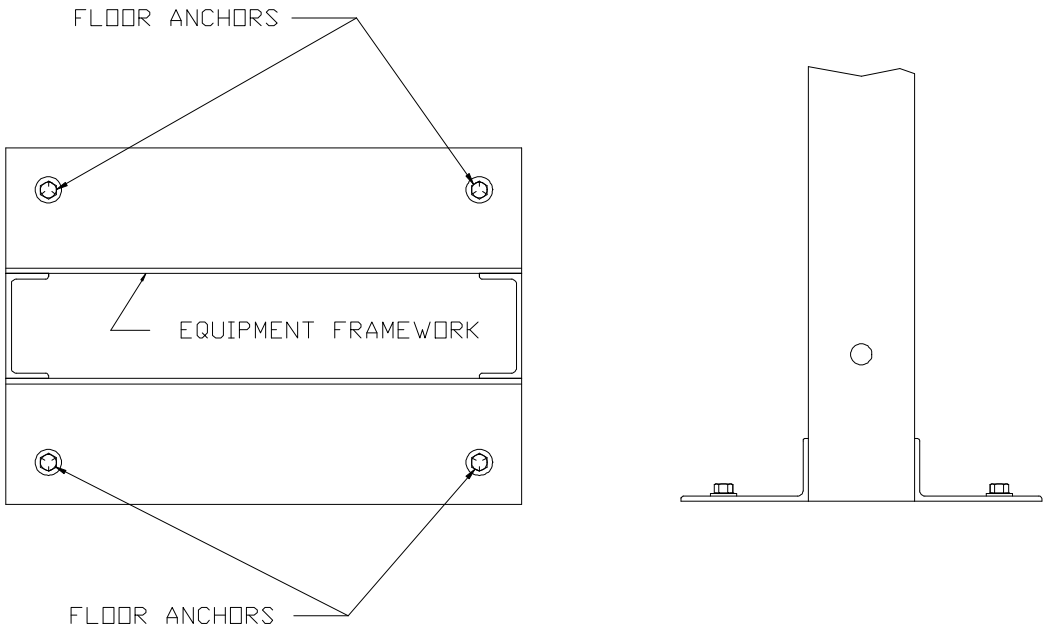
A. Grind concrete floor surface to desired level with sanding equipment. This method can generate a great amount of concrete dust and should never be performed in room with operating network equipment. This method is used only where floor deviations are slight.
B. Pour a top layer of filler material over uneven floor to level floor.

9.22 Floors requiring level correction locally at equipment frame areas shall be corrected by pouring filler material and feathering edges flush to surrounding floor . Use mortar material specified in Paragraph 9.08 for leveling. Prepare floor surface by removing floor covering, adhesives and roughening floor before applying mortar material.

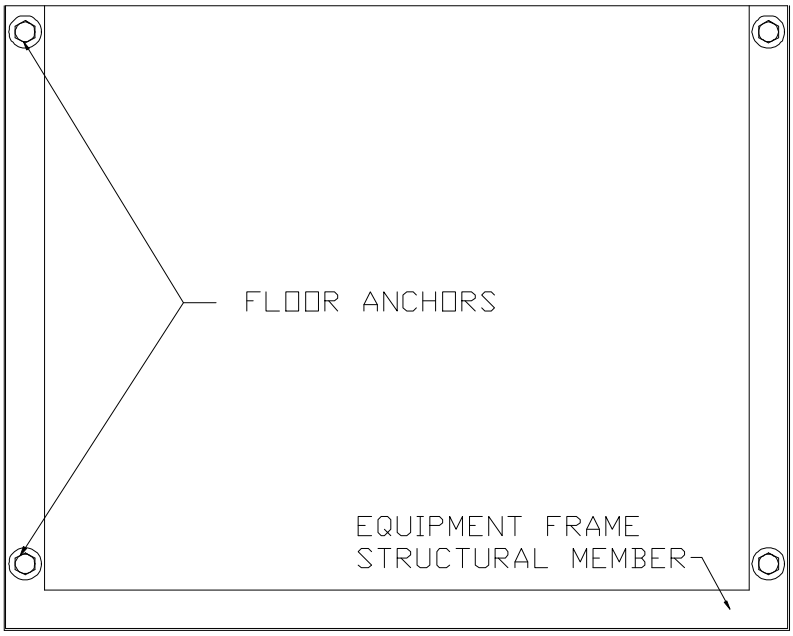
9.23 Uneven floors may make it necessary to correct equipment installations with large stacks of shims. These shims shall be installed per procedures described in paragraphs 6.26 through 6.29.



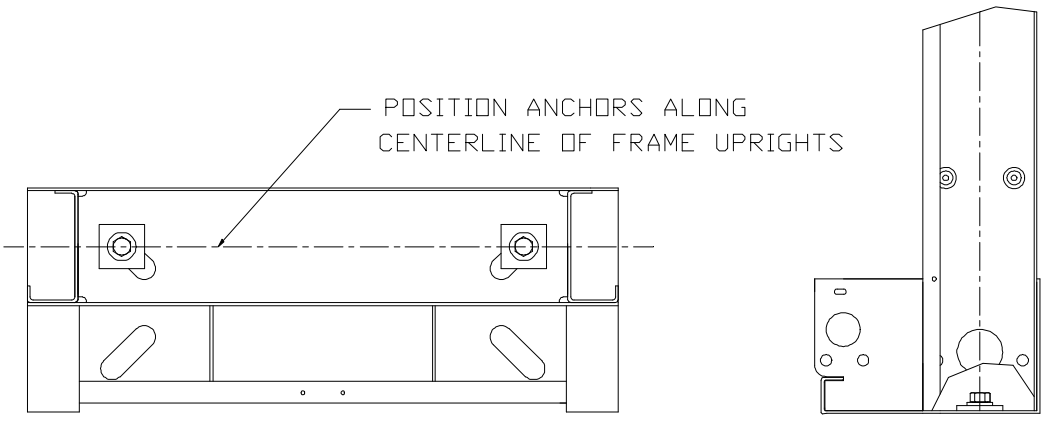
ANCHOR LOCATION
7' FREESTANDING FRAME
FIG. 1



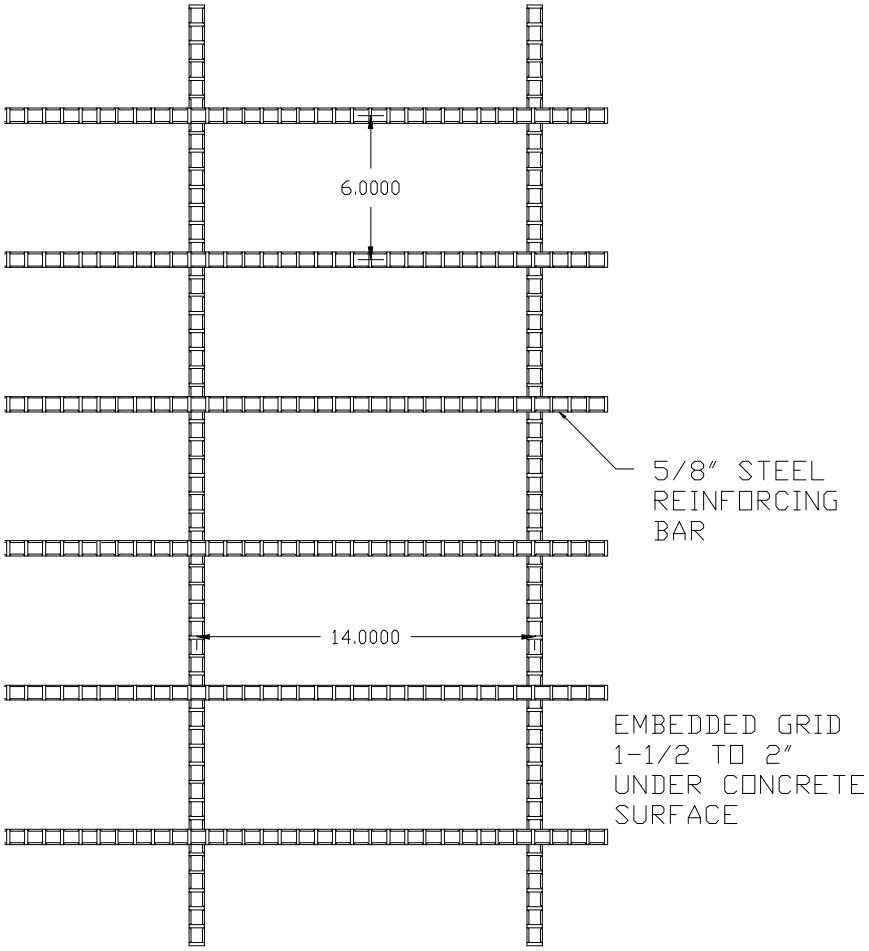
ANCHOR LOCATION
CHANNEL FRAMEWORK
FIG. 2



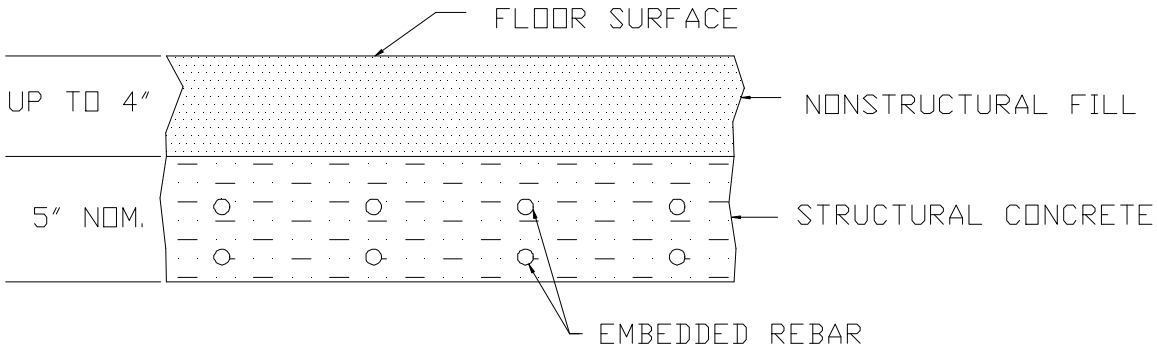
ANCHOR LOCATION
SHEETMETAL CABINETS, BDFB, DATA CABINETS
FIG. 3



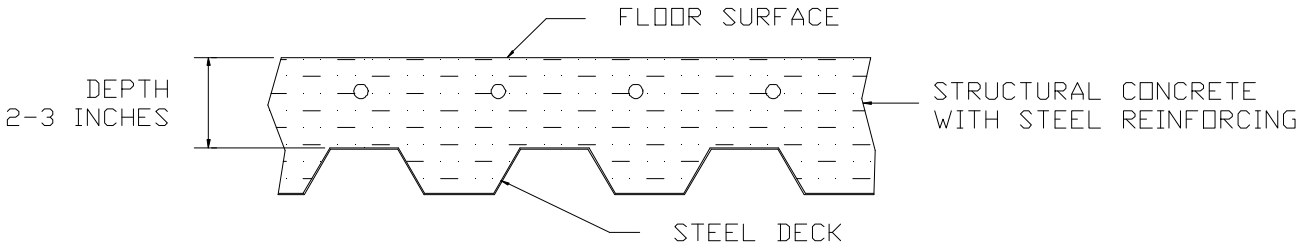
ANCHOR LOCATION
OVERHEAD SUPPORTED FRAMEWORK
FIG. 4



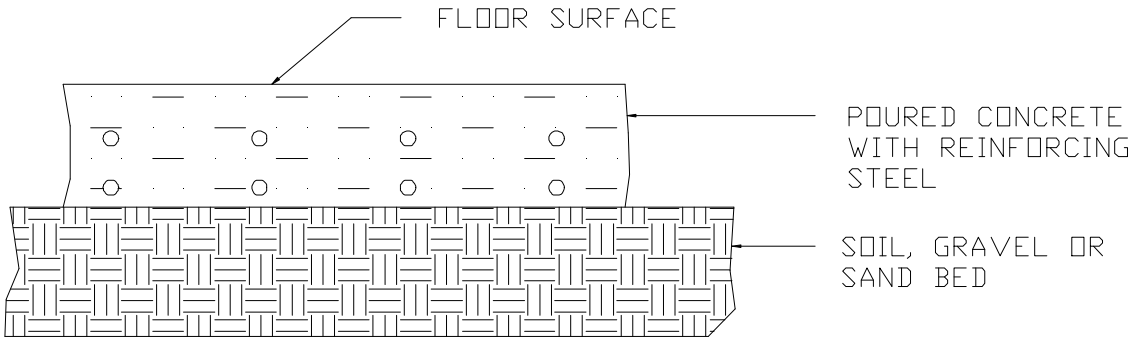
REINFORCEMENT STEEL IN CONCRETE FLOORS
FIG. 5



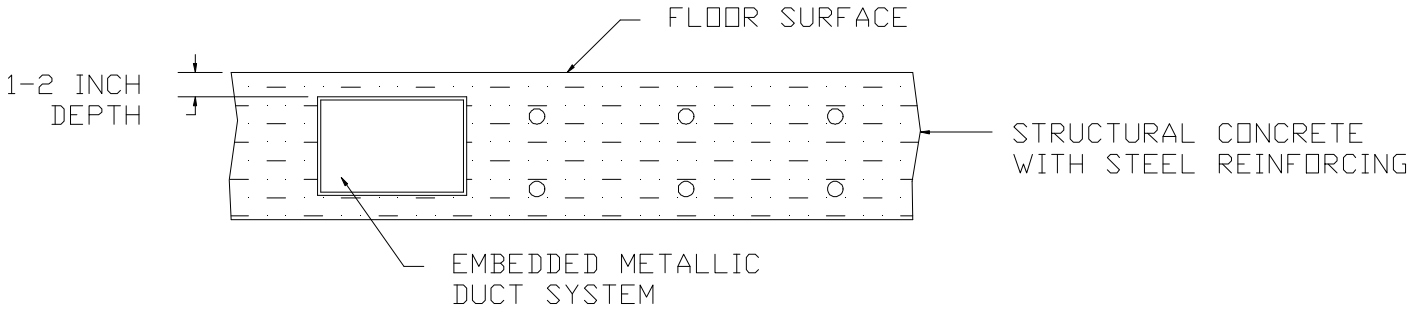
CROSS SECTION
LAYERED FLOOR CONSTRUCTION
FIG. 6



CROSS SECTION
CONCRETE PAN DECK FLOOR SYSTEM
FIG. 7



CROSS SECTION
SLAB ON GRADE
FIG. 8

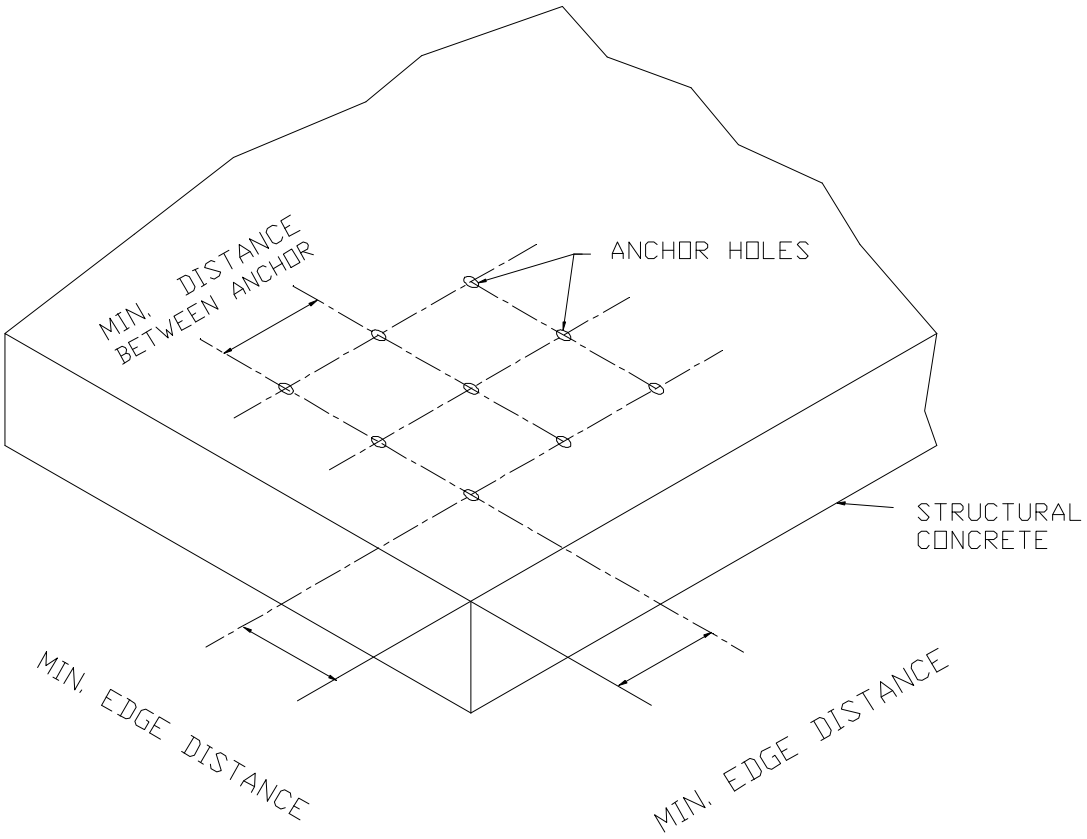


CROSS SECTION
EMBEDDED CONDUIT/DUCT
FIG. 9

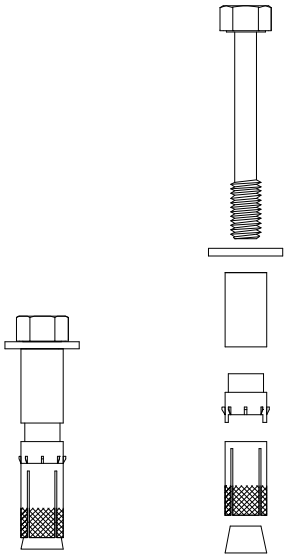
HILTI RV10 FERROSCAN REBAR LOCATOR

JAMES INSTRUMENTS PACOMETER
REBAR LOCATOR

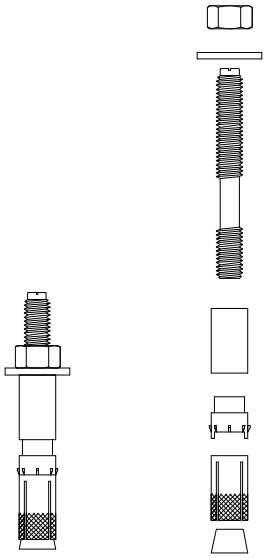
REBAR SCANNING EQUIPMENT
FIG. 10



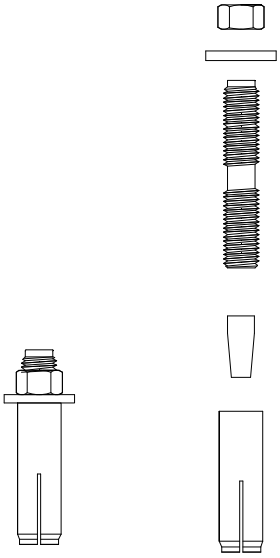
EDGE DISTANCE AND ANCHOR SPACING
FIG. 11



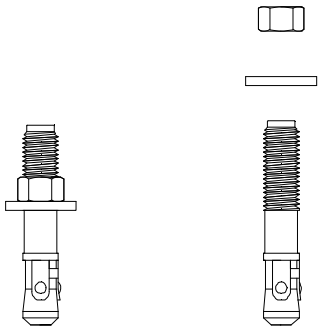
HILTI HSL ANCHOR
CAPSCREW VERSION



HILTI HSL ANCHOR
STUD/NUT VERSION

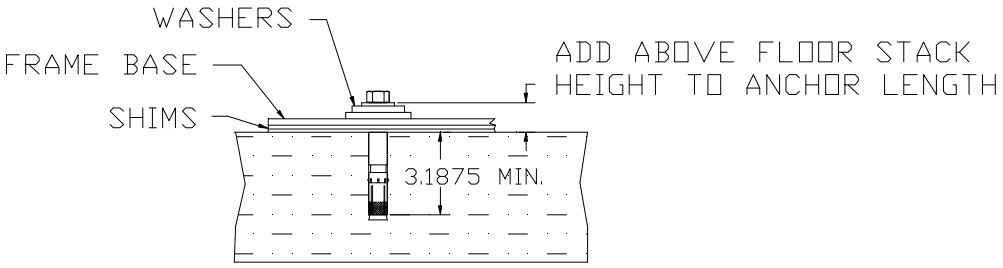


HILTI HDI DROP IN ANCHOR

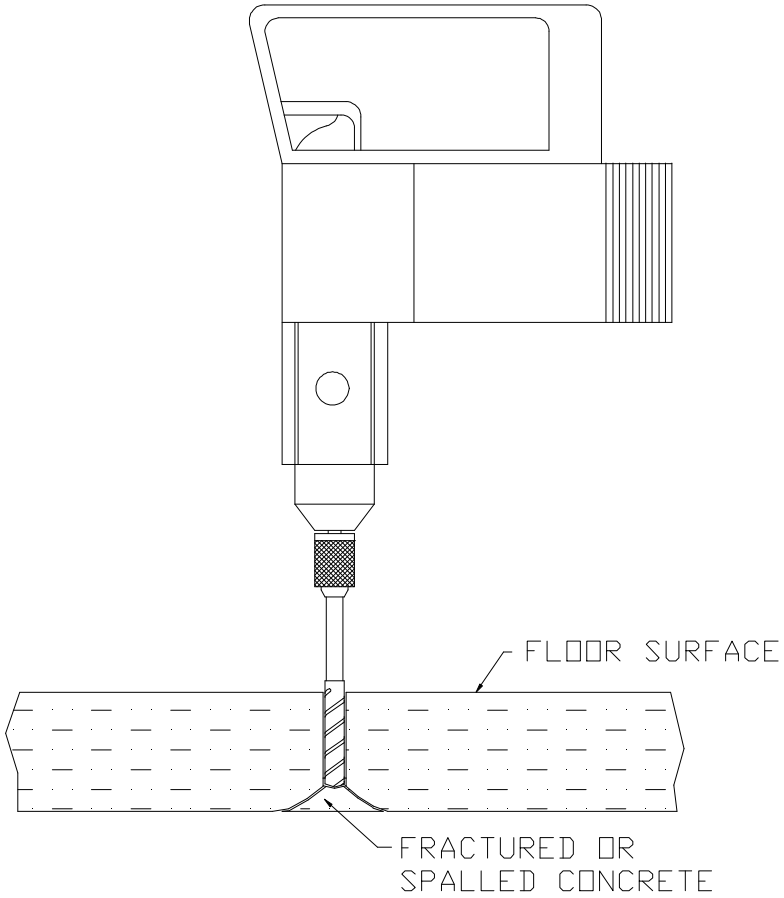


HILTI KWIK BOLT II ANCHOR

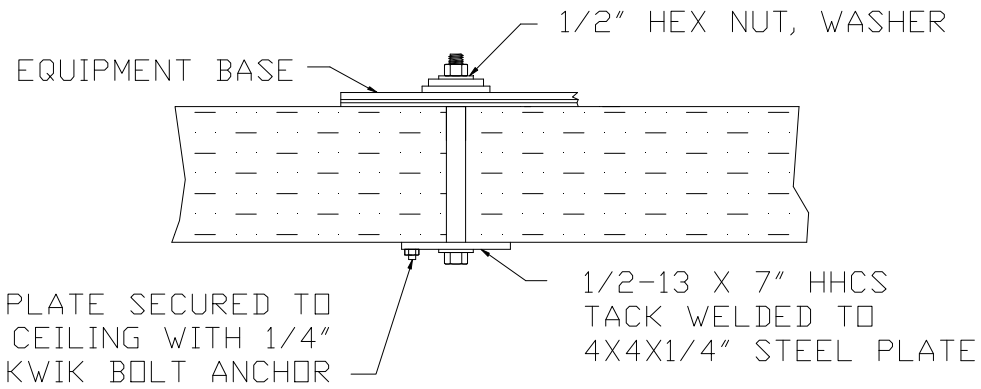
NETWORK EQUIPMENT FLOOR ANCHORS
FIG. 12



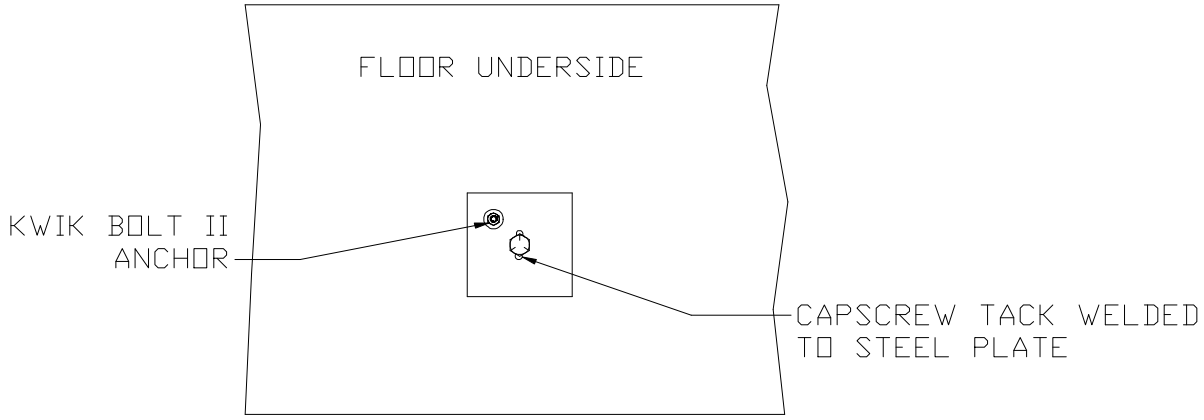
ANCHOR EMBEDMENT AND EQUIPMENT STACK HEIGHT
FIG. 13



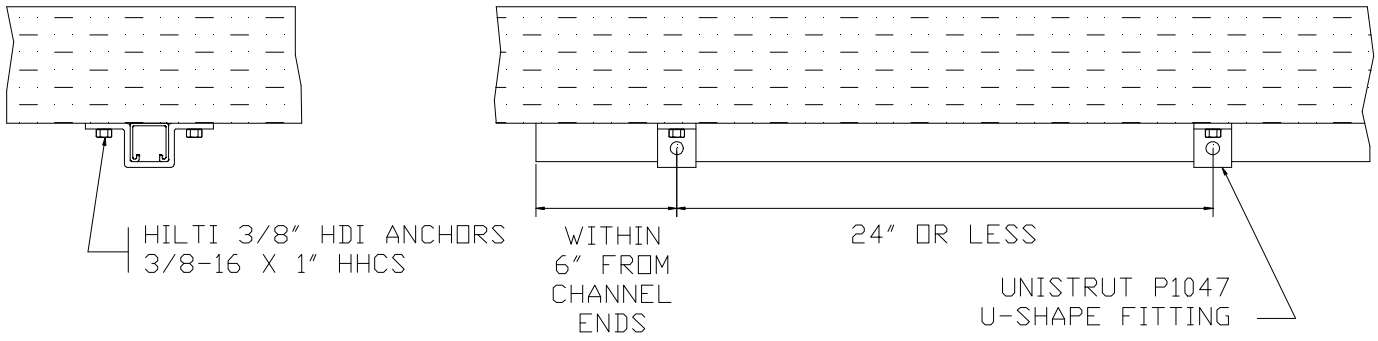
CONCRETE SPALLING
THIN CONCRETE FLOORS
FIG. 14



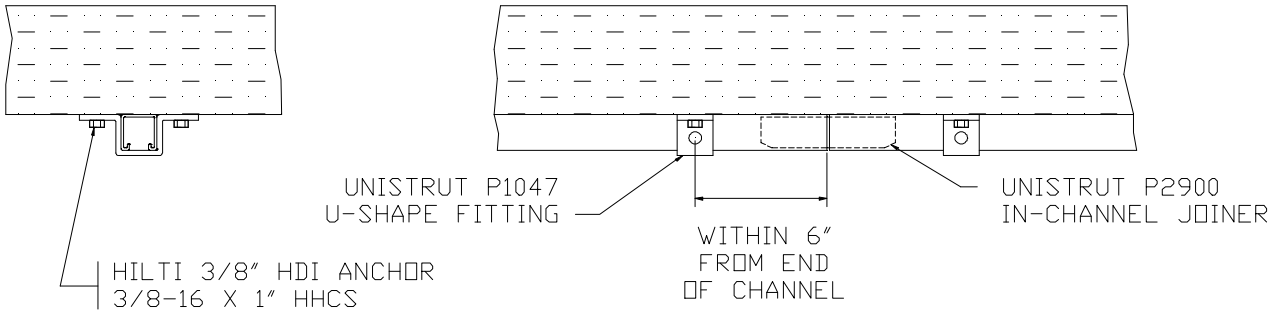
THROUGH BOLT ANCHOR
FIG. 15A



THROUGH BOLT ANCHOR
BOTTOM PLATE DETAIL
FIG. 15B

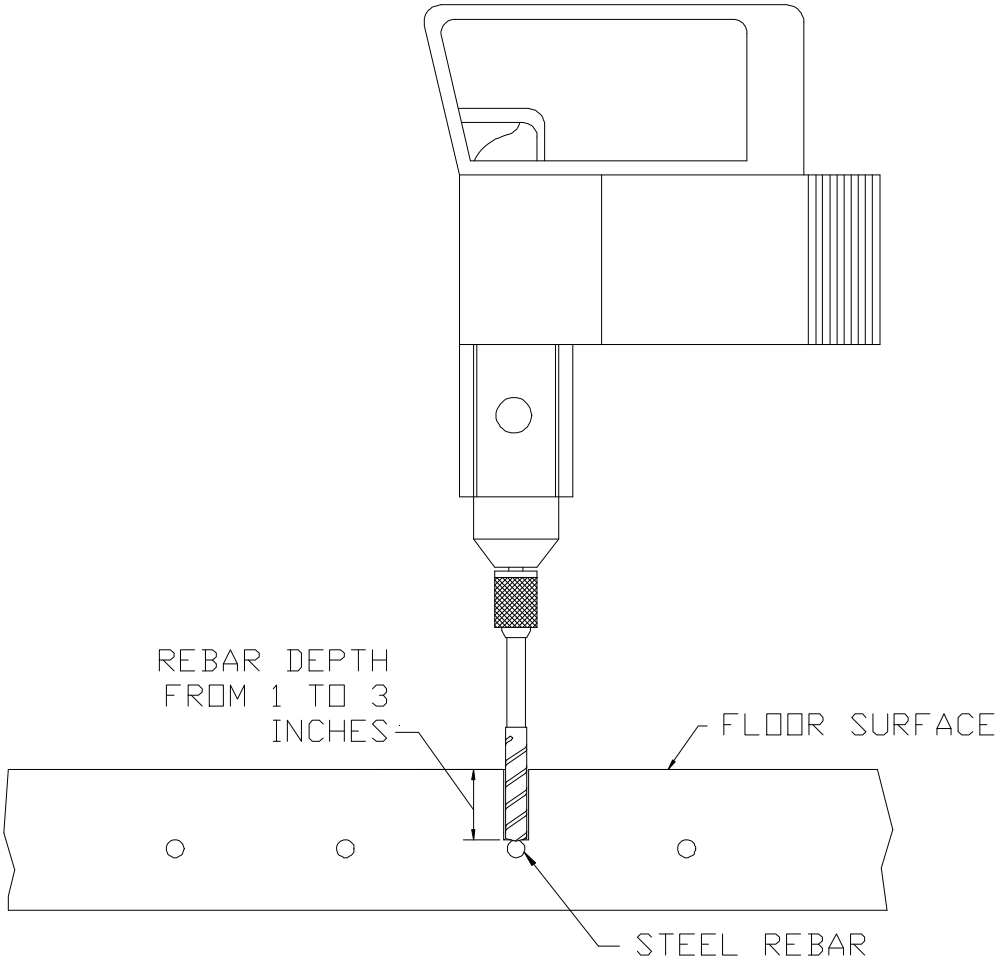


SURFACE MOUNT CHANNEL
SECURING REQUIREMENTS
FIG. 16

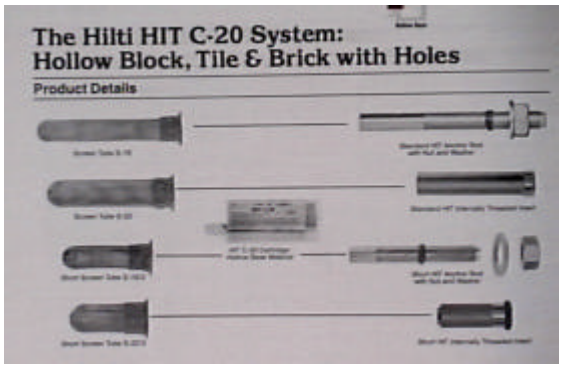


SURFACE MOUNT CHANNEL
JUNCTIONING REQUIREMENTS
FIG. 17

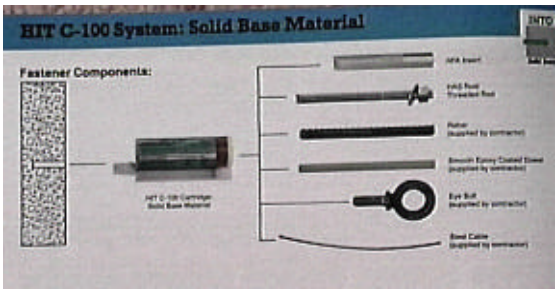
CAUTION: Rotating drill bit that strikes embedded obstacles such as rebar, rock, pipe will cause drill housing to twist and vibrate violently. Always use two hands on tool and side handle to control torque twist.



DRILLING OPERATION INTERFERENCE
FIG. 18



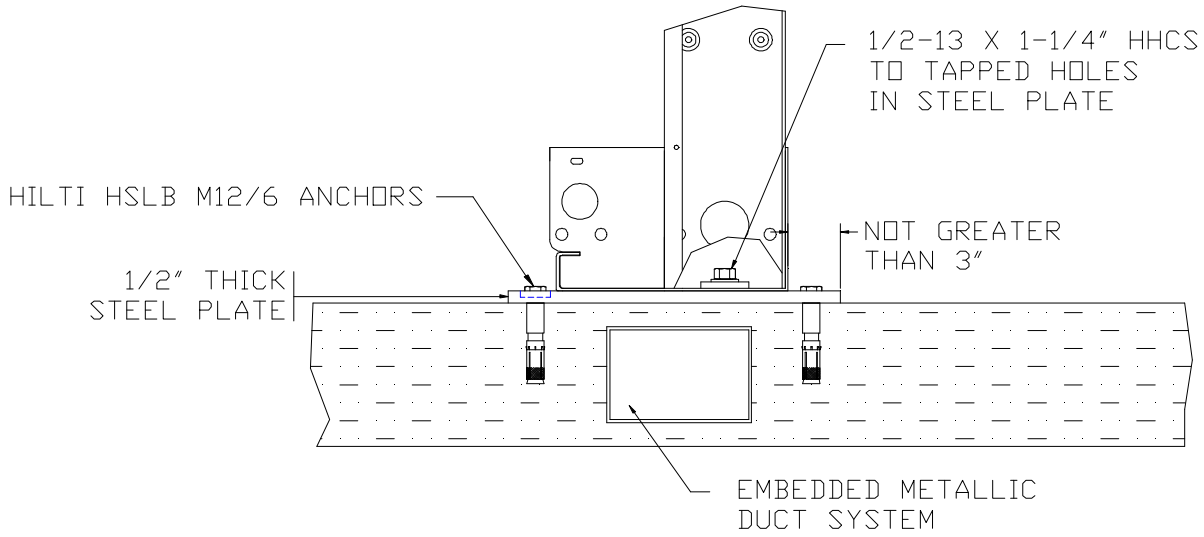
EPOXY SYSTEM FOR HOLLOW WALLS AND FLOORS



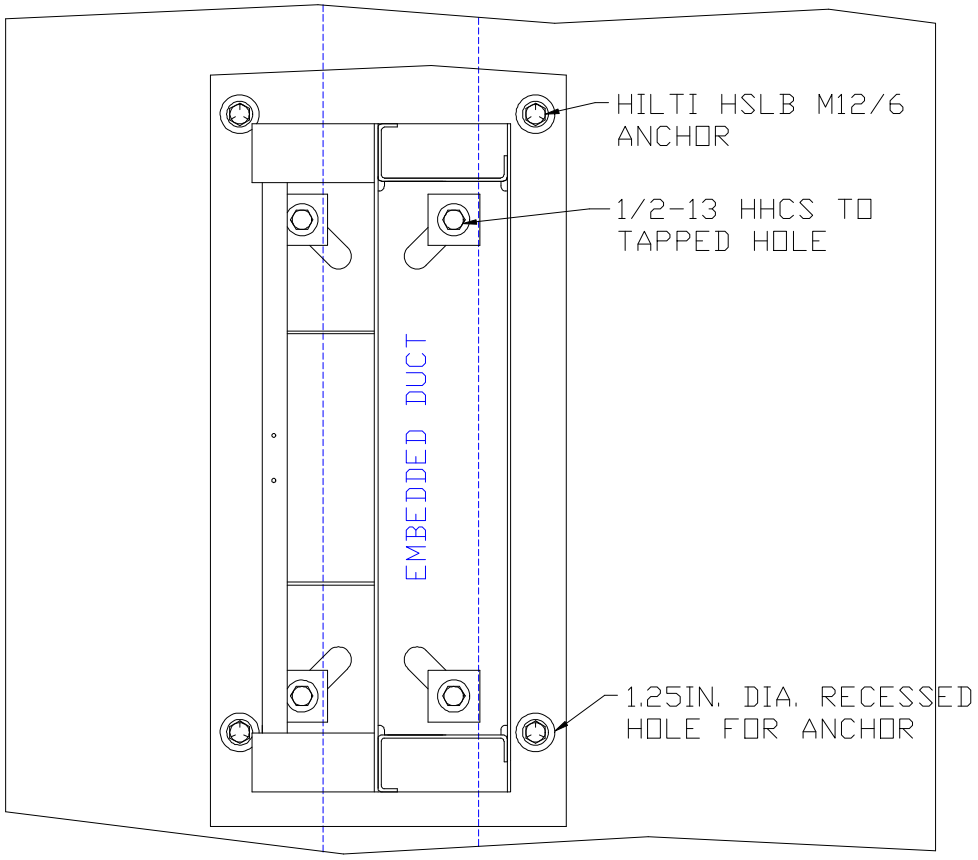
EPOXY SYSTEM FOR SOLID WALLS AND FLOORS

SCREENS AND INSERTS USED WITH EPOXY SYSTEMS

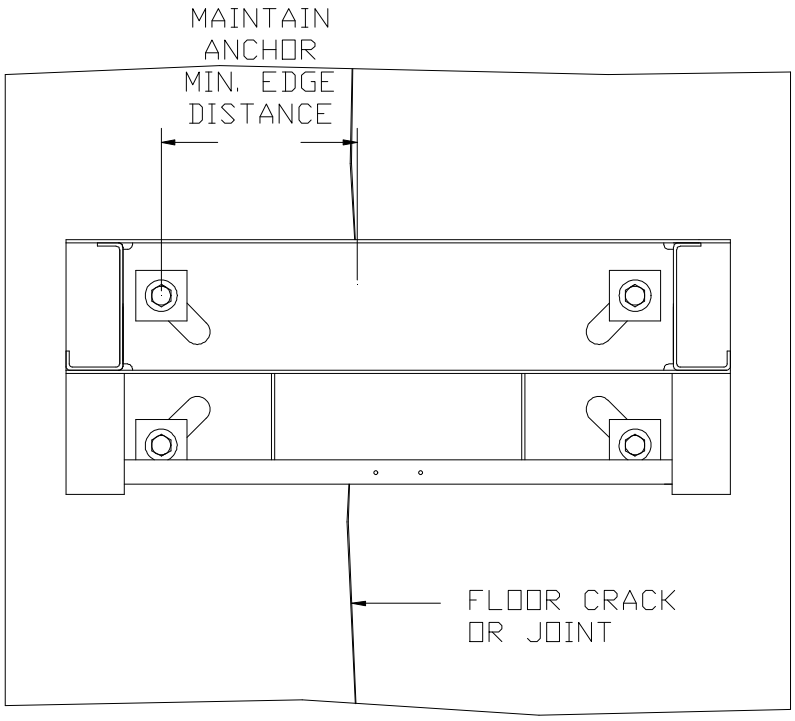
EPOXY ANCHORS
FIG. 19



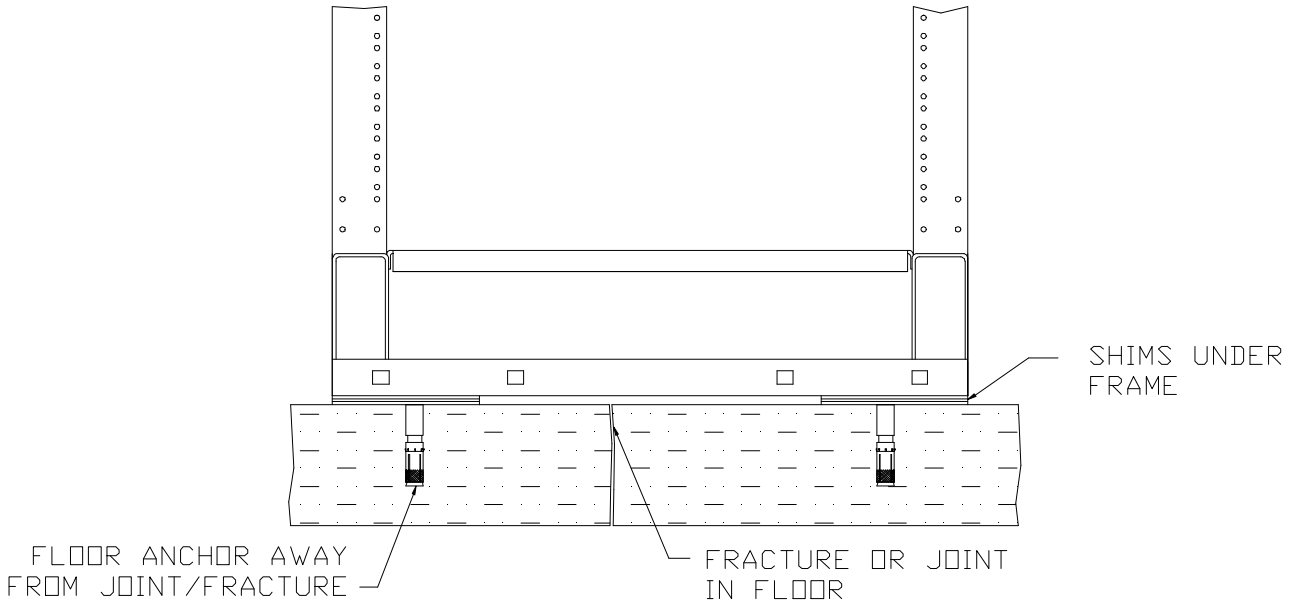
EQUIPMENT FRAMEWORK OVER EMBEDDED DUCT/CONDUIT
FIG. 20A



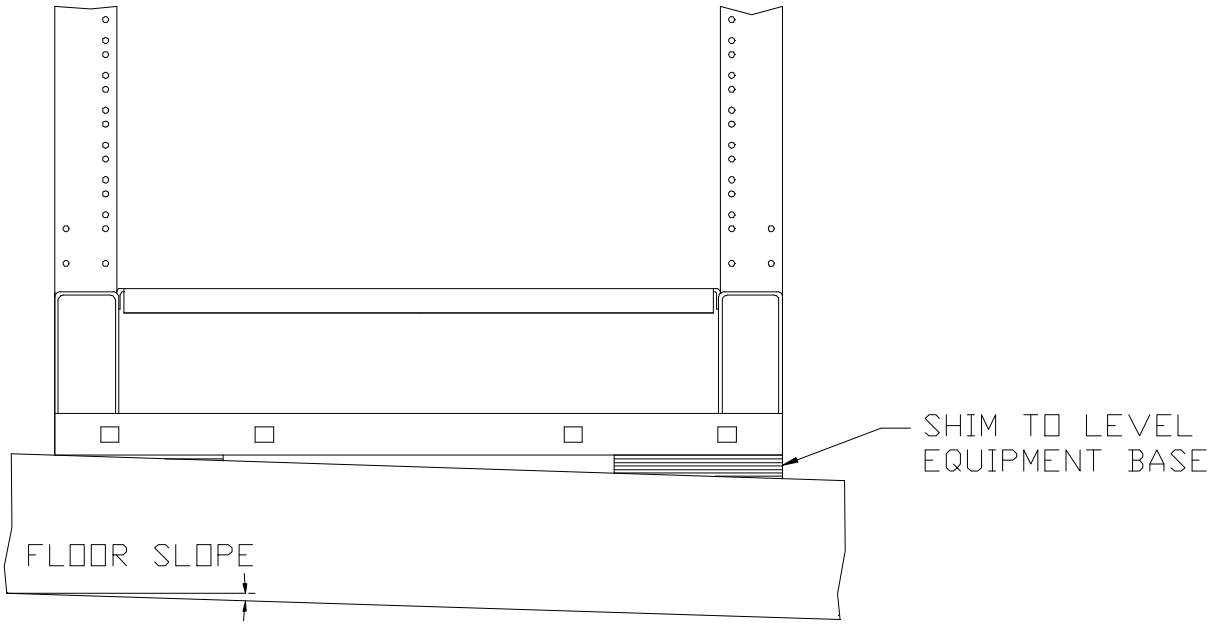
EQUIPMENT FRAMEWORK
STRADDLING EMBEDDED CONDUIT/DUCT
FIG. 20B



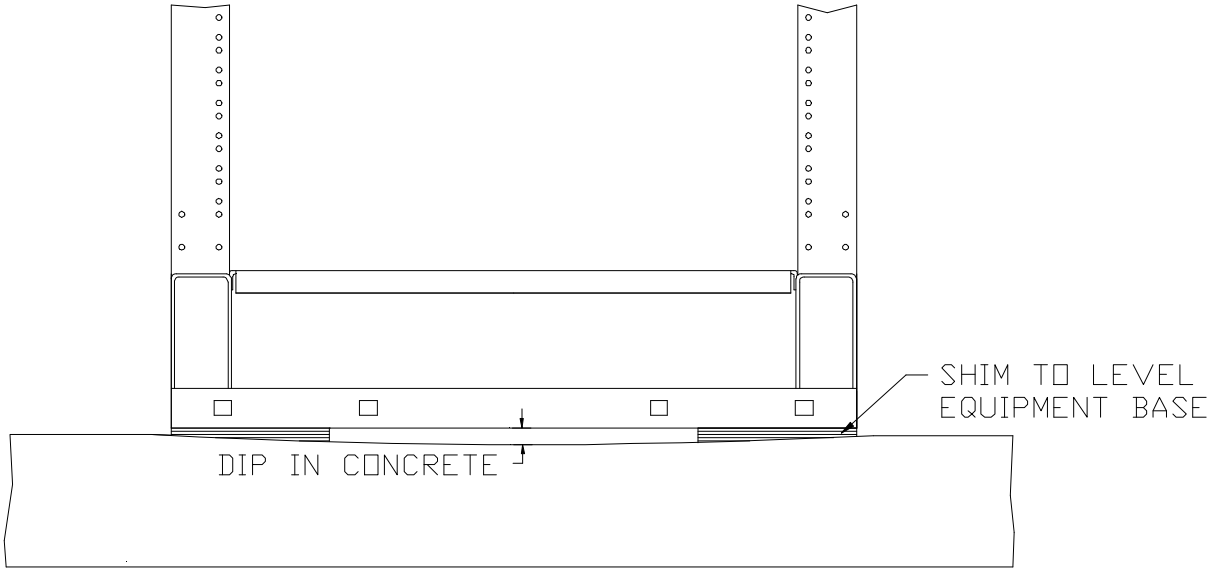
EQUIPMENT FRAMEWORK OVER FLOOR CRACK
FIG. 21A



EQUIPMENT FRAMEWORK OVER
FLOOR CRACK
FIG. 21B



FLOOR SLOPE
FIG. 22



FLOOR DIP
FIG. 23