## SECTION 8 -- CABLE RACK, AUXILIARY FRAMING AND LIGHTING SYSTEMS

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1. **CABLE RACK**

1.1. **General**

1.1.1 The Installation Supplier shall ensure, as part of the evaluation of the installation, that all equipment added, rearranged or modified is properly installed and in conformance with AT&T installation specifications.

1.1.2 The Installation Supplier shall ensure, as part of the evaluation of the installation, that all work has been done in accordance with the detail specifications or approved changes to the detail specifications.

1.1.3 This section covers apparatus requirements for cable rack deployed within AT&T Technical Space areas.
1.1.4 Changes in this issue of Section 8 are summarized in Table 8-1.

1.1.5 ATT-TP-76409 provides additional Technical Space cable rack requirements.

1.1.6 Anchoring requirements shall be in accordance with ATT-812-000-713.

1.1.7 Engineering of cable rack supports shall conform to the seismic risk level of the specific office.

1.1.8 Self-drilling anchors shall not be used for any applications in the equipment space under any circumstances. Only approved anchor designs such as Hilti HSL, HDI, Kwik-Bolt or epoxy anchors shall be used in the equipment area.

1.2. Description and Sizes

1.2.1 All new installations of cable racks shall:
   a) Be solid stringer (outside dimension of 2 inches by 3/8 inch) ladder-type in Technical Space equipment areas.
   b) Be 1-inch by 1/2-inch channel spaced on 9 inch centers and shall be welded to the stringers.
   c) Have first, last, and each alternate strap of the cable racks wider than 24-inches reinforced with a welded 1 x 1/4-inch bar.

1.2.2 Cable rack shall have a non-corrosive painted finish, while its assembly hardware (bolts, nuts, washers, clips, etc.) shall have a non-corrosive plated finish. Refer to ATT-TP-76201 for approved painted and electroplated finishes.

1.2.3 Refer to ATT-TP-76409. Only straight formed-wire bolt-on cable brackets (horns) shall be used for unsecured cable applications of office cable racks.
   a) Provide a sufficient quantity of cable rack horns to allow the installer to locate the horns on alternate straps of cable rack, spaced no more than 24 inches apart.
   b) Provide additional cable horns, as necessary, for installation at crossing points and points where cables drop off the racks.
   c) Provide additional cable horns, as necessary, for additional brackets to keep cable confined to cable racks.
   d) The height of the cable horn shall not exceed the cable rack’s maximum allowable cable pile up per Section J of ATT-TP-76300.
   e) Do not engineer or instruct the installer to place cable rack pans on inclined racks.
   f) Cable rack divider horns/brackets may be attached to cable rack cross-straps to separate single runs of cable on a wide rack.

1.2.4 Cable rack pans shall not be extended through a fire rated wall.

1.2.5 Panning material for new work and cable rack additions shall be plastic. Plastic panning shall be minimally 28% oxygen rated. Plastic panning shall be permanently marked or embossed.
with identification information. Legacy metal panning may remain in place until cable racks are removed or significantly modified.

1.2.6 Cable rack panning shall be provided in sufficient width to cover the cable rack without the need for multiple pans.

1.2.7 Cable rack with welded-on uprights (horns) shall not be provided.

1.2.8 Cable supporting brackets may be used for limited applications of dedicated cable runs.

1.2.9 Existing old style cable racks (C sided or Hollow) within legacy locations may be used to their original design fill limits.

1.3. **Location**

1.3.1 The location of a cable rack shall be such that the clearances required for installation and maintenance of the ultimate equipment arrangement will be maintained.

1.3.2 Figures 8-18 to 8-21 may be used as examples of cable rack configurations located above new equipment areas. The design of the cable distribution system is dependent on environmental and equipment requirements.

1.3.3 A cable rack shall not be located close to pipes, radiators, windows, doors, or any other equipment that may subject the cabling to detrimental conditions.

1.3.4 Cable rack height shall be the measurement between the top of the cable rack side bar down to the finished floor.

1.4. **Engineering Requirements**

1.4.1 Cable rack load limitations as stated in ATT-TP-76409 shall be considered when engineering new cable racks or when additional cables are added to an existing cable rack.

1.4.2 Cable racks shall not be supported from the cross-straips.

1.4.3 Horizontal cable rack should be supported on five foot centers, and the spacing between supports shall not exceed six feet.

1.4.4 Cable rack support shall be provided within 30 inches of the free end of a cable rack.

1.4.5 Adjustable cable rack stringer connectors or compression type splices may be used.

1.4.6 Permissible pile-up of switchboard cabling on cable racks for normal and maximum spacing of supports is shown in ATT-TP-76409.

1.4.7 Vertical switchboard cable runs shall not exceed an ultimate pile-up of 12 inches for switchboard cable racks or 7 inches for power cable racks within Legacy Technical Space.

1.4.8 The DESIGN ENGINEER shall engineer all cable mining activities to comply with ATT-TP-76300, Section Q.

1.4.9 The maximum width of horizontal and vertical dedicated power cable racks shall be limited to 1 foot 8 inches.
1.4.10 Safe loads for steel beam clamps, ceiling inserts, threaded rods, and lag screws, for the purpose of determining the spacing of supports other than normal are shown in ATT-TP-76409.

1.4.11 Cable leaving the cable rack shall not be unsupported for a distance greater than three feet for equipment bays and four feet for conventional distributing frames.

1.4.12 To protect cabling at T-intersections of bar-type cable rack and cross-aisle rack, finishing caps shall be provided for the ends of all cross- straps that project within the T-intersection area as shown in ATT-TP-76409.

1.4.13 Clamping details used for junctions of ladder-type cable racks are shown in ATT-TP-76409. Where separation of metallic continuity is required, fiber insulation shall be provided.

1.4.14 Sections of ladder-type cable rack shall be assembled so that support for the cabling is provided every nine inches. At turns or junctions, in vertical or inverted horizontal cable runs, where the turn of the cables is such that proper support is not provided for the cables, 1/8 inch by 1 inch flat bar shall be placed diagonally across the rack in a manner to provide proper support for the cables.

1.4.15 The longest length of sections, and the fewest parts practical, shall be provided. No more than one splice shall be placed between any two adjacent points of support on horizontal runs. Each cable rack section shall have at least one point of support. Cable rack splices shall not be construed as support. A splice shall not be used beyond the last point of support when the end of a rack extends in cantilever fashion.

1.4.16 Ladder-type cross-aisle cable racks may be installed at the same height as the ladder-type over-frame rack. Consideration shall be given to clear lighting conduit or other obstructions. Continuous runs of ladder-type cross-aisle cable racks fastened above and across, over-frame cable rack with J-bolt fastenings are permitted for addition to existing office configurations only and where ceiling heights are favorable.

1.4.17 Power distribution cables and grounding conductors may be supported by means of power cable support brackets in certain applications (see Section 12 for permitted power cable applications). Conditions that apply to their use:

a) Power cable brackets shall be supported from the main or end aisle cable rack stringers. Where there are no main or end aisle cable racks, the power cable brackets may be supported from auxiliary framing or strut.

b) Power cable brackets shall utilize a bolt to affix the bracket to the cable rack. Clip on type brackets, which are typically intended to support small gauge signal wire, are prohibited for this application.

c) Power cable brackets shall not be overloaded beyond the manufacturer’s recommendations, and the weight of the cables placed on them must be included in the limit calculations for the cable rack that is supporting them.

d) Dedicated power cable brackets can be used to support unfused or secondary (fused) power cable. Mixing unfused or secondary (fused) power cables on the same bracket
with grounding conductors, alarm wiring, voltage sensing leads, timing leads, or fiber riser
cable is prohibited. Mixing unfused power cable with any other type of cable is prohibited.

e) Power cable ran on power cable brackets shall be secured at every bracket.
f) In all grounding conductor applications, brackets shall be placed at a maximum interval of
20 inches. In all power cable applications, brackets shall be placed at a maximum interval
of 12 inches.

1.4.18 The open ended sections of ladder-type cable rack shall be protected with an approved
finishing cap.

1.5. **Support of Cable Rack**

1.5.1 Cable racks shall be supported by high- or low-type framing, other cable rack, threaded rods,
floor-mounted pipe stanchions, and approved wall or ceiling mounted brackets.

1.5.2 In low seismic risk locations both stringers shall be bolted at each end of the run and only one
bolt is required at intermediate supports on alternate sides of the rack.

1.5.3 In high seismic risk locations, both stringers shall be bolted at every support.

1.5.4 Ceiling hanger suspended auxiliary framing shall be provided to support cable racks over
equipment frames. Where ceiling hangers cannot be provided because of ceiling
inadequacies or access problems, the cable rack may be supported from building floor by
floor stanchions or equipment framework. Floor stanchion supported cable rack shall conform
to requirements of ATT-TP-76408. Five inch diameter circular or five inch square floor
stanchions shall be used for permanent stanchions. Two inch diameter “pipe stand” may be
used when the stand will be replaced in the future by an equipment frame due to line up
growth. Refer to ATT-TP-76409 for approved methods of wall supported cable rack.

1.5.5 Vertical cable rack used to support cables in shafts shall be supported at each floor and
ceiling level at the cable rack supporting framework.

1.5.6 Extended vertical runs of power cable rack, in excess of three floors, must have a minimum
of 20 foot horizontal cable rack provided on every third floor to alleviate cable weight build-up.

1.6. **Cabling Under Raise Access Floor**

1.6.1 Running cable under a raised access floor shall be done in a manner similar to running
cables overhead on a suspended cable rack.

1.6.2 Fire detection and grounding cables shall be run separate from transmission cables.

1.6.3 Primary power cables shall be located on and secured to cable rack.

1.6.4 For any new installations of under floor cable runs, cables shall be run on cable racks, basket
trays or other cable supporting structure to keep cables off building floor.

1.6.5 To prevent mixing of primary power cables with any other cable type cable cross aisle
bridges shall be used.

2. **AUXILIARY FRAMING**
2.1. General

2.1.1 Figures 8-18 to 8-21 may be used as examples of auxiliary channel configurations located above new equipment areas. The design of the cable distribution system is dependent on environmental and equipment requirements.

2.1.2 The following Practices provide additional information on auxiliary framing and bracing requirements

ATT-TP-76408 “Common Systems Network Facility Auxiliary Framing and Bracing Requirements”

ATT-812-000-713 “Network Equipment Anchoring Requirements”

2.1.3 Auxiliary framing shall be provided in longest sections and largest increments possible to minimize splice joints and provide greatest continuity in performance.

2.1.4 Compression type splices of horizontal runs of auxiliary framing shall be staggered at alternate runs and limited to no more than one splice between supports.

2.1.5 Primary auxiliary framing is the framing installed perpendicular to present or planned equipment frame lineups. This auxiliary framing serves as the primary means of support for office cable racks, equipment lighting and equipment frames within the equipment area.

2.1.6 Secondary auxiliary framing (sometimes referred to as supplemental framing) is framing installed above and perpendicular to the primary framing for seismic stiffening and supplemental cable rack support purposes. Secondary framing is generally a permanent component of the office auxiliary framing (superstructure) arrangement.

2.1.7 Auxiliary framing and auxiliary framing components shall be a non-corrosive plated type or painted. All assembly and securing hardware, including bolts, studs, threaded rods, nuts, washers, clips, clamps and similar material shall be non-corrosive plated type. Refer to ATT-TP-76201 for specifications on approved painted and electroplated finishes.

2.1.8 The protruding ends of lower level auxiliary framing shall be protected with an approved finishing cap.

2.1.9 Auxiliary framing heights shall be measured from the floor to the bottom of the paired channels.

2.2. Support Requirements

2.2.1 Where one or more additional row of frames is to be ultimately installed, the auxiliary framing shall be extended to allow for ultimate cable rack, ladder track, or lighting conduit.

2.2.2 In the placing of auxiliary framing a minimum clearance of 5 inches shall be maintained between the ends of the framing bars or channels and any building structural column, beam, wall, etc.

2.2.3 Locating the auxiliary framing under ceiling inserts will facilitate supporting the framing structure where frames are omitted. By locating alternate lines or sets of auxiliary framing immediately under the ceiling inserts, the auxiliary framing and cable rack can be temporarily supported by means of hanger rods.
2.2.4 Splicing of threaded rods should be avoided. When splicing is necessary, there shall be no more than one splice per rod. In no case shall splicing be done on threaded rod used to support mezzanine platforms.

2.2.5 Split nuts shall not be used to extend or add framing to existing threaded rods.

2.2.6 Auxiliary framing at the ends of frame line-up shall be located so that the distance between the end of the line-up and the last point of support will not exceed 2 feet 6 inches.

2.2.7 Frames and bays bolted together and supported from overhead to form, a continuous lineup shall have a top support approximately every 5 feet not to exceed 6 feet. Top support shall be understood to mean fastening with approved hardware to bars, channel or cable rack, independent of the frame itself, which are so constructed as to maintain the top positioning of the frame. Junction hardware between frames shall not be considered as top support. Cabinets and frameworks designed to be floor supported do not require top support.

2.2.8 Physically isolated frames that normally require overhead bracing must be provided with two top supports. Isolated frames shall be understood to mean frames which cannot be fastened to adjacent frames with junction hardware.

2.2.9 In general, placement of low type auxiliary framing over main or end aisles of an equipment area shall be avoided except as required for support of rolling ladder track or cable racking feeding non-continuous equipment areas.

2.2.10 Equipment frames taller than seven feet shall be secured to auxiliary framing in accordance with ATT-TP-76300, Section I.

2.2.11 Seven foot frames shall not be secured to auxiliary framing which is suspended from the ceiling. Refer to ATT-TP-76400, Section 5, for approved exceptions to this rule.

2.2.12 Auxiliary framing over power boards shall be installed only where required for the support of bus bars or cable rack above the power board.

2.3. Bracing

2.3.1 The entire auxiliary framing structure shall be braced in accordance with ATT-TP-76408.

2.3.2 Auxiliary framing shall be provided at cable holes and other openings in floors or walls as required to support the cable racks. Care shall be taken that framing will not interfere with the cabling at these openings.

3. ROLLING LADDERS (LEGACY TECHNICAL EQUIPMENT SPACE)

3.1. General

3.1.1 This unit covers the engineering requirements for rolling ladders and associated equipment such as ladder brakes and ladder track.

3.1.2 Surplus ladders, as provided by the AT&T Equipment Engineer, shall be utilized. The requirement for brakes for rolling ladders will be determined by the AT&T engineer based on local policy.
3.1.3 Rolling ladder systems should no longer be installed in central offices in new equipment areas as 7'-0" equipment height is the standard lineup configuration. The requirements are only intended to cover existing areas where ladders were previously placed.

3.2. Rolling Ladders - Track Type

3.2.1 Rolling ladders, 14 inches in width of the straight-type as shown in Figures 8-1 and 8-2, or of the platform-type as shown Figure 8-3, shall be furnished where aisle widths will permit. Ladders 12 inches wide may be furnished when aisle widths will not permit the use of 14 inch ladders. Ladders ten inches wide are considered special and are to be used only at the direction of the AT&T Equipment Engineer.

3.2.2 The number of steps for straight-type ladders of a particular vertical height may be determined from Figures 8-1 and 8-2. Straight-type ladders are furnished with 15 or fewer steps. Steps shall be finished wood, not coated with other covers, i.e., sandpaper, etc.

3.2.3 The number of steps for platform-type ladders of a particular vertical height may be determined from Figure 8-3. Platform-type ladders are furnished with eight or fewer steps below the platform.

3.2.4 Where a ladder serves both a Distributing Frame (DF) and other equipment frames, the handrail shall be located on the side away from the DF. The installer shall be directed to drill the left side of the ladder for handrail brackets, where required.

3.2.5 Rolling ladders shall be equipped with fenders as follows:
   a) Where the frame guardrails are located above the shoulder of the ladder wheel brackets.
   b) Ladders used in offices with cable duct frames having removable guardrails, shall be equipped with two wheelguards.
   c) Rolling ladders shall also be equipped with two wheelguards in line-ups where frames with guardrails extending to the floor are installed.
   d) Ladders used at DFs shall be equipped with one wheelguard located on the side of the ladder adjacent to the DF

3.2.6 The ladder shall be suspended from the upper support or hanger step by threaded rods. The effective length of the rods shall be such that the steps of the ladder are level.

3.2.7 Rolling ladders and ladder track at DFs shall be located as shown in Figure 8-4 and in accordance with the following:
   a) Where a ladder serves a DF on one side and relay racks or other frames on the other side, the ladder shall be located with respect to the DF;
   b) When a ladder serves a narrow-type DF of approximately the same width as, and in line with, relay racks or frames, the ladder shall be located as shown in Figure 8-5;
   c) Where a single line of ladders is located between DFs or between a protector frame and a DF, the ladders shall be located in the center of the aisle;
d) When the distance from the centerline of the ladder to the guardrail exceeds that recommended in Figures 8-4 through 8-6, the question of safety shall be reviewed with the AT&T Equipment Engineer.

3.2.8 At relay racks and Fuse Bays (FBs), ladders and ladder track shall be located as shown in Figure 8-5. Where a ladder is to serve a double line of frames, only one line of which is installed initially, the ladder shall be located in the center of the aisle between the present and future line of frames.

3.2.9 For frames, racks, or other equipment not specifically covered herein, the ladder locations shall agree with the locations shown on the illustrations for the equipment they most closely resemble.

3.2.10 The minimum clearance for a single or double line of ladders shall be as shown in Figure 8-6.

3.3. Rolling Ladder Track

3.3.1 Ladder track shall be provided, wherever practical, in sections eight feet and ten feet in length. The number of sections required for various overall lengths is given in Figure 8-7.

3.3.2 The ladder track shall be extended at the position of future frames to obtain access to distributing power terminal strips, fuse cabinets, aisle pilots, etc., located at the ultimate end of a line-up.

3.3.3 The length of the ladder track shall provide an overhang at the ends of the line-up for access to all of the equipment on the frames. It shall also be long enough to permit proper support from the auxiliary framing or other details provided.

3.3.4 A clearance of not less than 1 foot 3 inches between one end of the track and the wall toward which the ladder slopes shall be provided for the removal of the ladder trolley or brake from the track.

3.3.5 Ladder tracks shall ordinarily run continuously across aisles so as to permit concentration of ladders when necessary.

3.3.6 The end of the track toward which the ladder is inclined shall, where practical, extend sufficiently to permit placing a ladder stop 4 feet 2 inches beyond the end frame upright. The other end of the track shall extend a minimum of three feet beyond a ladder stop to permit entrance of maintenance equipment into the frame aisle. Ordinarily, the location of the stop in line with the end upright as shown in Figure 8-15 will meet this requirement.

a) Where the ladder track is installed close to and beyond a column so that the rolling ladder cannot pass the column, a platform-type rolling ladder is used and the stops located so that the ladder can approach the column without touching it;

b) Where the ladder track serves equipment in close proximity to partitions or walls, so that platform-type ladders have to be used to reach all of the equipment, the minimum distance from the end of the last frame to the center of the ladder stop shall be 12 inches.

3.3.7 Where low-type auxiliary framing is used, ladder track shall be attached directly to the underside of the auxiliary framing.
3.3.8 Ladder track shall be located as high as cable racks will permit where frames are supported by high-type auxiliary framing. At DFs supported by high-type auxiliary framing, it is desirable that the ladder track be located to take advantage of available headroom.

3.3.9 Continuous runs of ladder track shall be supported at approximately 5 foot intervals and in no case shall the spacing between adjacent supports exceed 6 feet 5/8 of an inch.

a) Provide at least two supports for each length of track supported from high-type auxiliary framing;

b) Provide at least one support for each length of track supported from low-type auxiliary framing or cable rack, except that end pieces shall have not less than two supports;

c) Track shall not extend cantilever-fashion more than three feet beyond a support if the trolley traverses the entire length of the extension. If the travel of the trolley in the extension is limited by a stop bolt, the total extension beyond the last support shall not exceed four feet. In this case, the distance from the last support to the stop bolt may be up to three feet and the track may extend beyond the stop bolt. Figure 8-15 illustrates conditions that may be encountered.

3.3.10 Tracks shall be supported from auxiliary framing or the ceiling in steel frame and concrete buildings as shown in Figures 8-8 through 8-11. Where proper support cannot be obtained with auxiliary framing, additional framing shall be installed.

3.3.11 When support from a cable rack is required, tracks shall be fastened as shown in Figures 8-9 through 8-14. The supporting details shall be fastened not more than one foot from the cable rack support.

3.3.12 When ladder tracks are to be supported from cable racks that utilize hanger rods, 5/8"-11 hexagon nuts shall be placed above the cable rack hanger clips.

3.3.13 Where ladder tracks are to be located under cable racks that are supported by low-type auxiliary framing, the track shall be secured in accordance with Figures 8-12 through 8-14.

3.3.14 A ladder stop shall be installed at each end of the track as shown in Figure 8-15. Ladder stops shall be equipped with cotter pins as shown in Figure 8-16. Where rubber plugs per Figure 8-17 are installed, the plug may be used as a stop.

3.3.15 Ladder track ends shall be equipped with a protective plug when:

a) Two lines of track are non-continuous in the same aisle and the ends of the track overlap.

b) The ladder track has the potential of being a service or personnel safety hazard. When a ladder track plug is required it may serve as the rolling ladder stop. The plugs shall be installed as shown in Figure 8-17.

4. CABLE DISTRIBUTION SYSTEMS

4.1 General

4.1.1 This section covers the equipment requirements for engineering of a system of cable racking called cable distribution systems.
4.1.2 Cable distribution systems are a cable management system which provides a means for cable separation.

4.1.3 Cable distribution systems and assembly hardware shall be of a non-corrosive finish.

4.2. **Applications**

4.2.1 Cable distribution systems are provided over line-ups of equipment frames and are fastened to adjacent line-ups by cross-aisle racks, which are considered to provide a unitized top support for associated frames.

4.2.2 Where frames are not provided under cable distribution systems, support stanchions shall be provided at five foot, not to exceed six foot intervals and at junctions of cable distribution system sections. Sufficient clearances shall be maintained to allow for future addition of frames.

4.2.3 Cable distribution systems shall be provided for the ultimate growth of an individual line-up whenever possible to allow for proper distribution of cabling and top support.

4.2.4 Where cable from cable distribution systems is run to common systems such as DF and power, gray ladder type cable rack and support shall be provided.

4.2.5 Where cable distribution is part of an isolated bonding network, separation or insulating hardware shall be used between the two cabling systems.

    **Caution:** When cable distribution systems and associated equipment are located within the isolated bonding network, separation from all common bonding network members must be maintained.

4.2.6 Application of cable distribution systems shall take into consideration cable access to frames. Certain types of cable distribution systems limit access to high cable volume frames and may require cover removal or modification.

4.2.7 Cable distribution systems shall be designed in conformance with local seismic risk conditions.

4.3. **Fiber Optic Cable Distribution Systems**

4.3.1 Fiber optic jumper/patch cord cable shall be installed using its own identified dedicated fiber path (Fiber Protection System or Wire Basket Tray).

4.3.2 Fiber optic trunk type cable should be installed using its own identified dedicated fiber path (cable rack), but may be routed via switch board racking if approved by the office Implementation Engineer due to cost, environmental restrictions, etc. If switch board and fiber trunk cable are to utilize the same routing system they should be bundled and separated as much as feasible.

4.3.3 The use of inner-duct shall not be used within the cable distribution system or between equipment lineups.

4.3.4 Excessive fiber optic tie cable slack shall be routed and secured on dedicated fiber slack storage racking sized to accommodate minimum bending radius.
4.3.5 On fiber cable runs of less than 300ft, allowable slack shall be no more than 10% of the overall length of the run or rounded up to the next 10ft increment.

4.3.6 Example: Required cable length = 96’

Allowable slack = 9.6’

Cable length + slack = 105.6’

Next 10’ cable increment = 110’ cable total allowable length

On fiber cable runs greater than 300ft, allowable slack shall be no more than 30ft.

Excess fiber equipment cord slack shall be stored at either the network element cable management system or the FDF cable management system, depending on space availability, while maintaining the minimum fiber bend.

4.3.7 OSP Fiber optic cable service loops terminating to fiber distribution frame must maintain minimum bending radius.

4.4. Wire Basket Tray (WBT) or Fiber Protection System (FPS)

4.4.1 The WBT or FPS represents a separate and unique fiber optic protection cable routing system used only for fiber optic equipment cords that are run between two independent equipment termination points or an equipment termination point and the office FDF.

The WBT or FPS will provide:

- protection of fiber optic patch cords from installation activities
- an additional means of providing fiber separation and protection from other types of cabling
- both primary and secondary fiber optic equipment patch cord routing capability.

The FPS ductwork shall be ‘Yellow’ in color; the WBT ‘Pre-Galvanized’ or ‘Electro Zinc’.

4.4.2 The use of covers on horizontal FPS runs only is NOT required. This applies to all FPS within AT&T Facilities and includes both overhead and under floor applications. All transitional sections of FPS, i.e. those going from one level to another including vertical or diagonal runs, shall be required to have covers. All vertical FPS runs shall be required to have covers as well as all FPS transitional turndowns, downspouts, express exits, etc. End Caps shall be required at the ends of all horizontal and vertical straight sections of FPS where those ends are not connected to an additional section of FPS.

4.4.3 When placing WBT or FPS, enough vacant space is to remain between the top of the duct and any obstruction (e.g. ceiling, racks) to allow for the safe and easily installation of fiber equipment cord by the office technician.

4.4.4 FPS maximum allowable unsupported fiber guide overhang measured from last support shall not exceed 18-inches for two, four and six inch FPS; and spacing of the fiber guide supports shall be placed every four to six feet.

4.4.5 The WBT or FPS shall be placed in a horizontal matrix configuration. Its actual design shall allow efficient routing of fiber equipment cords between Network Elements. A WBT drop out
or FPS downspout should be installed for each equipment bay requiring access to the routing system.

4.4.6 The WBT or FPS shall be designed according to fiber equipment cord cabling needs. The design shall take the current and future equipment/FDF fiber equipment cord needs into consideration. The WBT or FPS over an FDF designated lineup should be provisioned with a minimum of 12" wide horizontal duct and 4" wide vertical dropouts.

4.4.7 The minimum duct size for overhead horizontal FPS is 4 inches, and for WBT it is 6 inches.

4.4.8 When placing 12" or larger FPS within equipment environments using auxiliary channel for superstructure support, if threaded rod supports are required, the installation vendor shall use 5/8" threaded rod only.

4.4.9 Straight sections of 12" FPS shall be supported on both sides of each junction within 6" to 12" of the junction. A maximum distance of 5' between supports shall be required.

4.4.10 Twelve inch FPS fittings (T's, elbows, crosses, downspouts etc.) shall have support brackets placed directly beneath each fitting. If it is not possible to place the support bracket directly beneath the fitting then the support bracket shall be placed beneath the FPS straight section as close to the fitting as possible.

4.4.11 When placing 12" FPS fittings, whenever possible, support brackets shall be attached to the underside of the fitting with the self-drilling screws supplied by the manufacturer. If support brackets cannot be attached to the underside of the fitting using the self-drilling screws, then variable fitting support locators shall be used.

4.4.12 A FPS shall be considered at capacity when equipment fiber cords come within ½ (one half) inch of the top of the FPS. WBT tray is at capacity when equipment fiber cords reach 50% of basket fill. Fiber equipment cords shall not be placed within the WBT or FPS with excessive slack.

4.4.13 Fiber trunk cable shall not be placed in the WBT or FPS routing system.

4.4.14 In cases where space is limited and there is no room for dedicated fiber racking, cable rack horns that mount on the sides of cable racks and include an integral means of providing cable support/separation may be used where necessary for the support of fiber optic cabling. Such horns are generally referred to as compartment horns and shall be installed on racks no more than 12 inches apart. Compartment horns shall not be mounted on vertically oriented cable rack below the 7-foot height level.

4.4.15 On all new builds “L” brackets, “J” hooks, or cable rack horns shall not be used.

Exceptions:

a) In smaller offices like Huts the use of compartment horns is permitted where installing cable racking is cost prohibitive.

b) In those locations, such as Legacy-T offices, that do not have any dedicated fiber cable racking and use compartment horns exclusively for their routing needs.

c) In locations where there are pre-existing cable runs utilizing compartment horns it is permissible to use these runs until they become exhausted.
4.5. Fiber Diversity

4.5.1 Definitions

a) Diversity is defined as “working” and “protected” circuits placed in separate routes.

   Note: Diversity is applicable between FDF’s and NE’s or between two NE’s.

4.5.2 There is no physical diversity requirements for any SPEED or OC rate unless that requirement is requested by the customer, engineer or the equipment OEM.

More stringent Levels of diversity may be required due to specific customer requests, marketing product requirements or specific network requirements.

Refer to appropriate AT&T document for specific diversity requirement.

4.5.3 The FDF will be treated as the common cable entrance and cross-connect point. When there is a need for a fiber optic connection to equipment on another floor or at a distant location on the same floor, a tie cable will be terminated in a shelf on the FDF and will be directly terminated on a new satellite FDP on that other floor or distant location. This will be accomplished in one of the following methods:

a) Preferred method: Placement of an FDP within the appropriate equipment framework at both the ‘A’ and ‘Z’ ends of the desired fiber tie cable. Then the use of a pre-connectorized tie cable of the appropriate cable length routed between and terminated at the appropriate FDP. Refer to figure 8-32a.

b) Preferred alternate method: Placement of an FDP within the appropriate equipment framework at both the ‘A’ and ‘Z’ ends of the desired fiber tie cable. Then the use of a pre-terminated (one end only) tie cable of the appropriate cable length terminated at the FDF. The non-connectorized stubbed end of the tie cable is to be field spliced with the appropriate connectors and then terminated on the satellite FDP. Refer to figure 8-32b.

c) Alternate method: Placement of an FDP within the appropriate equipment framework at both the ‘A’ and ‘Z’ ends of the desired fiber cable tie. Then the use of a pre-terminated (one end only) tie cable of the appropriate cable length terminated at the FDF. The non-connectorized stubbed end of the fiber cable is to be field spliced with the appropriate connector pigtail assembly within a fiber splice tray located at the satellite fiber frame location. The connector pigtail assemblies are to be terminated on the satellite FDP. This method should only be used when absolutely necessary. Refer to figure 8-32c.

Note-1: New FDP equipped with fiber tail described as being installed within the FDF for explanation purposes only. This panel may be installed at either the near or far end of the fiber tie depending on installation needs.

Note-2: The Detail Engineering Service Provider (DESP) shall insure that all fiber optic tie cables terminating at either an FDF or FDP shall secure the fiber cable end points utilizing a fiber cable clamp/grommet. The fiber cable securing clamp/grommet shall be attached to the fiber termination shelf if there is a designated place on the shelf itself to do so. If there is no designated place on the terminating shelf then the clamp/grommet shall be placed on the bay
upright. Multiple clamps/grommets may be used if necessary to facilitate proper cable slack management.

4.6. FDF Panel Diversity (OSP)

4.6.1 When OSP cable is brought into a location and those cables are routed diversely, all the way to the FDF (LGX), it is an acceptable practice to terminate these cables within the same bay as long as these cables are terminated in separate FDP (LGX) shelves. These cables must be routed on opposite sides of the bay as well. If in the event pre-terminated fiber shelves are being used then there could be a situation where both cables will be running on the same side of the bay. This is allowed as long as the cables take diverse routes after leaving the bay.

5. FRAME AND AISLE LIGHTING – LIGHT EMITTING DIODE (LED)

5.1. General
5.1.1 This section outlines engineering requirements for framework supported lighting systems employing LED fixtures. See Section 6 of ATT-TP-76400 for emergency lighting and general building lighting.

5.1.2 In some Processor Logic Control (PLC) systems LED lighting is provided as an integral part of the equipment. In such cases, the manufacturer’s specifications for lighting shall be followed.

5.1.3 All wiring, conduit and fixtures installed in Non-Regulate/Non-Utility locations shall meet the requirements of the National Electrical Code (NEC), local building code and shall be Listed.

5.1.4 For lumen levels see Section 6 of ATT-TP-76400.

5.1.5 See Section 13 of ATT-TP-76400 for grounding of equipment in the conduit system.

5.1.6 AC lighting in battery, power and engine rooms shall utilize fixtures with protective covers that will reasonably prevent the dislodging or shattering of the light due to activity (e.g., “egg crate” grill or cage assemblies).

5.1.7 All LED light fixtures shall be equipped with positively fixed lamp guards.

5.1.8 Any 120 Volt AC branch circuit shall be as follows:
   a) 15 Ampere Fuse/ACB shall not exceed 1440 Watts;
   b) 20 Ampere Fuse/ACB shall not exceed 1920 Watts.

   Electrical load for circuits supplying electrical load for LED fixtures shall be calculated by multiplying the lamps wattage by 1.25 (this will compensate for LED Driver).

5.1.9 Typical arrangements shown on manufacturer’s drawings may be varied to meet job requirements. Lighting fixture assemblies, other than those specified on the manufacturer’s standard equipment drawings, shall be furnished only with the approval of AT&T.

5.1.10 See ATT-TP-76400, Section 6.8.2, for additional information on equipment lighting.

5.2. Engineering Requirements

5.2.1 The DESIGN ENGINEER shall provide the installer specific work items for the placement of conduit, fixtures and switches for frame and aisle lighting.

5.2.2 All equipment lighting apparatus including wire and electrical raceways shall be listed for its purpose by a nationally recognized testing laboratory.

   Note: specific products are required by organizations within AT&T. Follow specific fixture requirements as directed by the AT&T Engineer. All fixtures shall be installed per the manufactures guidelines.

5.2.3 Conduits should be securely fastened at 5'-0" intervals, and shall not exceed 6'-0".

5.2.4 Conduit shall not be run in locations normally occupied by auxiliary framing, cable racks, etc.

5.2.5 Conduit shall, where possible, be run parallel and adjacent to superstructure to assure maximum headroom and to provide easy access to cable racks.

5.2.6 Conduit shall not be run on cable racks.
5.2.7 See ATT-TP-76400, Section 12, for approved conduit types.

5.2.8 The conduit system for a light fixture shall support only that fixture. The conduit fittings shall be compression style. Screw type couplings are not acceptable.

5.2.9 Lighting circuits supplied by multiphase service shall be assigned to balance the load on the different phases as closely as practicable.

5.2.10 Lighting equipment and appliance outlet circuits shall not be supplied by the same branch circuit.

5.2.11 Wiring for both shall be run in the same conduit wherever possible.

5.2.12 Motor wiring shall be run in a separate conduit.

5.2.13 No more than ten trolley-type appliance outlets shall be assigned in a single-branch circuit.

5.2.14 All LED type lighting fixtures over equipment areas shall be rigidly attached and shall not be supported with chains.

5.2.15 NRTL listed solderless connectors shall be used for making all splices in junction boxes and fixtures.

5.2.16 Light fixtures in equipment areas shall be connected to PDSC lighting panels dedicated to network lighting and supplied by essential AC Power.

5.2.17 Light fixtures in equipment areas shall be installed such that the lowest part of the fixture is at a minimum height of 7'-3" when installed in a line-up of 7'-0" equipment frames. When the existing auxiliary framing height prevents achieving the 7'-3" requirement, the installer shall insure that the fixture is secured directly to the bottom of the low level framing.

5.2.18 All new aisle line ups shall have motion sensors installed to control the lighting system. A Physical Switch in the bay end guard is not required and should be avoided unless a physical restriction does not allow the proper functionality of the motion sensor.

5.2.19 When 3-way switches for controlling equipment aisle fixtures are located in the endguard, the switches shall be located at each end of the aisle.

5.2.20 When adding to an existing lineup of fluorescent fixtures, it is recommended that fluorescent fixtures be added.

5.2.21 When a new lineup is being added, LED fixtures shall be used, even when the existing fluorescent fixtures in other lineups have not been retrofitted.

5.3. Lighting Control

5.3.1 Motion Sensors shall be used for controlling lighting fixtures unless otherwise directed within this document. Motion Sensor switching of equipment area lighting has been determined to be appropriate and effective.

5.3.2 Lighting extensions of existing line-ups may be installed using switched lighting rather than motion sensors.

5.3.3 The DESP shall survey the area of installation and shall determine if motion sensors or switched lighting shall be used.
5.3.4 Motion sensors having a 360º throw pattern usually come with optional lens covers or masking so the sensors’ field of view can be restricted to a narrower pattern. The throw pattern shall be adjusted to completely cover the work area.

5.3.5 The minimum time delay setting on switches and/or sensors shall be 10 minutes. Local Management may request a longer delay, not to exceed 20 minutes.

5.3.6 Lighting fixtures controlled by Motion Sensors shall not also have switches.

5.3.7 Emergency egress lighting shall not be controlled by Motion Sensors.

5.3.8 The use of sensors utilizing line voltage power sources (120/277 VAC) are preferred because they generally require less apparatus being added into equipment overhead arrangements. The following motion sensing products have been approved for use in AT&T facilities. Also listed are the applications considered appropriate for each product.

<table>
<thead>
<tr>
<th>Manufacture</th>
<th>Model</th>
<th>Voltage</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airey-Thompson</td>
<td>5511-S1</td>
<td>Line</td>
<td>Equipment aisles with Sentinel fixtures</td>
</tr>
<tr>
<td>Sensor Switch</td>
<td>CMRB series</td>
<td>Line</td>
<td>Side/end of box type fixtures</td>
</tr>
<tr>
<td>Wattstopper</td>
<td>CI-355-1</td>
<td>Line</td>
<td>Short aisles and entry doors</td>
</tr>
<tr>
<td>Wattstopper</td>
<td>CX-100-4</td>
<td>24 Volts</td>
<td>Equipment Aisles</td>
</tr>
<tr>
<td>Leviton</td>
<td>OSFHU</td>
<td>Line</td>
<td>Equipment Aisles</td>
</tr>
<tr>
<td>Airey-Thompson</td>
<td>551179S1</td>
<td>Line</td>
<td>Fixture w/ sensors or equipment aisles</td>
</tr>
<tr>
<td>Airey-Thompson</td>
<td>551329S1</td>
<td>Line</td>
<td>Fixture w/ sensors or equipment aisles</td>
</tr>
<tr>
<td>Airey-Thompson</td>
<td>552329S1</td>
<td>Line</td>
<td>Fixture w/ sensors or equipment aisles</td>
</tr>
<tr>
<td>Airey-Thompson</td>
<td>55LED1WWT841K9S1</td>
<td>Line</td>
<td>1 Lamp Fixture w/ sensors for equipment aisles (Where “WW” = lamp wattage)</td>
</tr>
<tr>
<td>Airey-Thompson</td>
<td>55LED2WWT841K9S1</td>
<td>Line</td>
<td>2 Lamp Fixture w/ sensors for equipment aisles (Where “WW” = lamp wattage)</td>
</tr>
</tbody>
</table>

The above list will be updated as similar products are evaluated and deemed appropriate and have the same functionality.

5.3.9 For illustration on motion sensors layout and installation refer to Figures 8-31a and 8-31b.

5.3.10 Motion Sensors shall be positioned such that every part of the aisle is within the “view” of a sensor and no point shall exceed 25’ from the “view” side of a sensor.

5.4. Lamps and Ballast

5.4.1 T-8 LED lamps shall be used.

5.4.2 T8 LED electric drivers shall be used.

5.5. Lighting Parts
5.5.1 For equipment areas with overhead racking and raised floor cooling one of the lighting systems listed below shall be used.

a) For equipment Technical Spaces other than VHO/SHOs, Airey-Thompson shall be used. See Common Systems Minor Materials List for ordering information. See Figure 8-30 for typical installation.

b) For VHO, SHO and other non-traditional Technical Spaces, ceiling or wall mounted wrap around fixture from H.E. Williams, Inc. may be used. For installation and ordering information contact www.hew.com or call 417-358-4065.
NOTE - Lower fixture assemblies are to be tapped to mount wheelguard when guard is required on lower fixture assembly; the fixture shall be drilled and tapped by the installer.
Figure 8-2--Straight-Type Rolling Ladder Assembly with Brake

NOTE - When handrail is assembled to the siderail, the end brackets shall be so located that the handrail is tight between the two end brackets.
FIGURE 8-3--PLATFORM-TYPE ROLLING LADDER ASSEMBLY

<table>
<thead>
<tr>
<th>NUMBER OF STEPS</th>
<th>STRAIGHT LADDER</th>
<th>EQUIVALENT PLATFORM LADDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>7</td>
<td></td>
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<tr>
<td>15</td>
<td>8</td>
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</tr>
</tbody>
</table>
FIGURE 8-4--LOCATION AND CLEARANCE FOR LADDERS AT DISTRIBUTING FRAMES

**TABLE**

<table>
<thead>
<tr>
<th>FRAME</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOOR TYPE DISTRIBUTING OR GROUPING FRAMES WITH ANGLE IRON GUARD RAILS</td>
<td>10 1/4&quot;</td>
<td>11&quot;</td>
</tr>
<tr>
<td>DUMMIT TYPE DISTRIBUTING FRAME</td>
<td>1 1/8&quot;</td>
<td>1 1/8&quot;</td>
</tr>
<tr>
<td>DISTRIBUTING FRAME WITH SHEET METAL BASE</td>
<td>SEE NOTE</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. Certain distributing and grouping frames in crossbar offices have a sheetmetal base with guardrail six inches from the floor similar to that used on all crossbar switch frames. Ladder fenders, therefore, are not necessary at these frames.

2. Dimension "A" for the crossbar Line Distributing Frame (LDF) shall be 12" because of 6 point bunching blocks located in the upper portion of the frame. A 14" ladder will always be used at the LDF. Dimension of "A" for all of the various grouping frames in crossbar and toll switching offices shall be as shown where the frames are isolated; where they are arranged with regular crossbar frames to that one ladder will serve two lines of frames, the ladder track shall be located in the center of the aisle.

3. In order to prevent jumper wire from becoming entangled with lower fixture assemblies, a wheelguard shall be furnished on the frame side of all ladders at DFs in all offices.

4. The fender assembly shall be located on the siderail adjacent to the guardrail with the caster contacting the center of the guardrail.
FIGURE 8-5--LOCATION AND CLEARANCE FOR LADDERS AT RELAY RACKS FUSE BAYS, CROSSBAR, AND STEP-BY-STEP FRAMES

NOTES:

1. Dimension "A" for fuse boards having a 12 inch guardrail shall be 8-1/2 inches, 9-1/2 inches or 10-1/2 inches for 10 inch, 12 inch and 14 inch width ladders respectively.

2. Wherever in crossbar offices (all types) a 14 inch width ladder serves a single line of frames and space will permit, the track shall be located 13 inches from the guardrail.

<table>
<thead>
<tr>
<th>LADDER WIDTH</th>
<th>A USUAL</th>
<th>MIN.</th>
</tr>
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<tbody>
<tr>
<td>10&quot;</td>
<td>8&quot;</td>
<td>7 1/4&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>9&quot;</td>
<td>8 1/4&quot;</td>
</tr>
<tr>
<td>14&quot;</td>
<td>10&quot;</td>
<td>9 1/4&quot;</td>
</tr>
</tbody>
</table>
FIGURE 8-6--MINIMUM CLEARANCE FOR SINGLE AND DOUBLE LINES OF LADDERS

NOTE:
Where the "B" dimension is greater than that shown, the ladder shall be centered between the guardrail and the centerline of the column deviating from this location only to the extent required to maintain the necessary 2-1/4 inch clearance between the ladder siderail and the base of the column. Where print display boards are located on the centerline of the column row, this 2-1/4 inch minimum shall be increased to 3 inch to allow a 5 inch clearance between the ladder siderail and the display board lighting fixture.

<table>
<thead>
<tr>
<th>LADDER</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>10&quot;</td>
<td>7 1/4&quot;</td>
<td>1' - 2 1/2&quot;</td>
<td>2' - 5 3/4&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>8 1/4&quot;</td>
<td>1' - 4 1/2&quot;</td>
<td>2' - 9 3/4&quot;</td>
</tr>
<tr>
<td>14&quot;</td>
<td>9 1/4&quot;</td>
<td>1' - 6 1/2&quot;</td>
<td>3' - 1 3/4&quot;</td>
</tr>
</tbody>
</table>
### FIGURE 8-7--NUMBER OF SECTION OF TRACK REQUIRED FOR VARIOUS LENGTHS OF TRACK

<table>
<thead>
<tr>
<th>LENGTH OF TRACK</th>
<th>NUMBER OF SECTIONS OF TRACK REQUIRED</th>
<th>LENGTH OF TRACK</th>
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<td>6</td>
<td></td>
<td>118</td>
</tr>
<tr>
<td>62</td>
<td>3</td>
<td>4</td>
<td>120</td>
</tr>
<tr>
<td>64</td>
<td>4</td>
<td></td>
<td>122</td>
</tr>
</tbody>
</table>

**NOTE:** For total length greater than 120 feet, the number of lengths of track may be determined by adding the number required for the length in excess of 120 feet to the number required for 120 feet as listed in above table.
FIGURE 8-8--TRACK SUPPORTED PARALLEL TO/OR AT RIGHT ANGLES TO AUXILIARY FRAMING, PARALLEL SHOWN
FIGURE 8-9--TRACK SUPPORTED DIRECTLY FROM AND AT RIGHT ANGLES TO AUXILIARY FRAMING
FIGURE 8-10--TRACK SUPPORTED FROM AND AT RIGHT ANGLES TO AUXILIARY FRAMING - SLOPING TRACK - 2 INCH DIFFERENCE IN AUXILIARY FRAMING LEVEL

- CONDUIT CLAMP
- BOLT
- CLIPS
- BUSHING
- HEX. NUT
- 3/32" X 3/4" COPPER PIN
- HANGER BRACKET
- TRACK

20'-0" MIN

- SLOPING TRACK
- AUX FRAMING

L 1/2" APPROX
SEE VIEW A
L 1" APPROX
SEE VIEW A
L 1 1/2" APPROX
SEE VIEW A
L 2" APPROX
FIGURE 8-11--TRACK SUPPORTED FROM AUXILIARY FRAMING WITH EXTENSION ROD

CLIPS

SELF LOCKING NUT

5/8 - 11 HEX NUT

1 1/2" X 1/4" CLIP

SELF-LOCKING NUT

5/8 - 11 THD ROD

3/16 X 1" HANGER CAP SCR

HANGER BRACKET

TRACK
FIGURE 8-12--TRACK SUPPORTED WITH EXTENSION RODS FROM CABLE RACK 2 FEET 1 INCH OR LESS WIDE - TRACK AND PARALLEL WITH CABLE RACK
FIGURE 8-13—TRACK SUPPORTED WITH EXTENSION ROD AND CABLE RACK MORE THAN 2 FEET 1 INCH IN WIDTH
FIGURE 8-14--TRACK SUPPORTED WITH SINGLE BAR DIRECTLY FROM CABLE RACK 2
FEET 1 INCH OR LESS WIDE
FIGURE 8-15--LOCATION OF END SUPPORTS AND LADDER STOPS IN TRACK

NOTES:

1. Preferred location but not necessarily a maximum. Where space permits and if requested by SWBT, the end of the track may be extended to permit the stop to be located any distance beyond the 4' 2" shown, providing the requirements governing the number and spacing of the track supports are met.

2. When the ladder track serves equipment in close proximity to partitions or walls, so that platform-type rolling ladders have to be used to reach all the equipment, the minimum shall be 1" - 0".

3. When the ladder track is installed close to and beyond a column so that the rolling ladder can not pass the column, a platform-type rolling ladder is used and the stop located so the ladder can approach the column without touching it.

4. When ultimate requirements for an office are furnished initially, the ladder stops shall be located at the ends of the ladder track.
FIGURE 8-16--LADDER STOP AT SUPPORT BRACKET

SIDE OF SUPPORT SHALL NOT EXTEND BEYOND END OF TRACK

SOFT RUBBER BUSHING 1 1/4 OD

BRACKET

3/32 X 3/4 COTTER PIN

3/8-16 X 2 3/4 HHM BOLT

3/8-16 HEX NUT

SECT A-A
FIGURE 8-17--LADDER TRACK PLUG

.438" x 1" x .032" 
WASHER

3/32" x 3/4" COTTER PIN

SHAFT

LADDER TRACK PLUG
FIGURE 8-18A – TYPICAL CROSS SECTION OF NEW AREA WITH 3-TIERED CABLE RACKING
INTERNAL RETURNS AND EXTERNAL RETURNS AT SIDE OF BDFBs
FIGURE 8-18B – TYPICAL CROSS SECTION OF NEW AREA WITH 2-TIERED CABLE RACKING
INTERNAL RETURNS AND EXTERNAL RETURNS AT SIDE OF BDFBs
FIGURE 8-19A – TYPICAL PLAN VIEW OF NEW AREA WITH 3-TIERED CABLE RACKING INTERNAL RETURNS AND EXTERNAL RETURNS AT SIDE OF BDFBs
FIGURE 8-19B – TYPICAL PLAN VIEW OF NEW AREA WITH 2-TIERED CABLE RACKING
INTERNAL RETURNS AND EXTERNAL RETURNS AT SIDE OF BDFBs
FIGURE 8-20A – TYPICAL CROSS SECTION OF NEW AREA WITH 3-TIERED CABLE RACKING EXTERNAL RETURNS AT REAR OF BDFBs
FIGURE 8-20B – TYPICAL CROSS SECTION OF NEW AREA WITH 2-TIERED CABLE RACKING 
EXTERNAL RETURNS AT REAR OF BDFBs
FIGURE 8-21A – TYPICAL PLAN VIEW OF NEW AREA WITH 3-TIERED CABLE RACKING
EXTERNAL RETURNS AT REAR OF BDFBs
FIGURE 8-21B – TYPICAL PLAN VIEW OF NEW AREA WITH 2-TIERED CABLE RACKING EXTERNAL RETURNS AT SIDE OF BDFBs
FIGURE 8-28 – DOWNSPOUT DROP OPTIONS
FIGURE 8-29 – EXPRESS EXIT DROP OPTIONS
FIGURE 8-30 – AIREY-THOMPSON MOTION SENSOR INSTALLATION.
FIGURE 8-31a - TYPICAL DYNAMIC SWITCH LAYOUT (EXAMPLE)
Below provides general construction notes:

1. Coordinate fixture location within aisle on an aisle-by-aisle basis with AT&T Mobility prior to rough-in and mount from existing auxiliary framing. Coordinate with AIREY–THOMPSON for appropriate mounting hardware.

2. Indicates luminaire with integral motion sensor.

3. Indicates an unswitched luminaire (based on model specified and wiring shown).

4. Integrate ceiling mounted occupancy sensor (Wattstopper UT-355-1) with existing lighting in this room.

5. Replace lamps and ballast in existing luminaire with new to match that specified for similar new luminaire type 'L36'.

6. Existing inverter conduit installed low in this area area shall be relocated to a higher elevation. Trace circuit and coordinate cut-over with AT&T Mobility. For bid purposes assume that completely new conduit/wiring will be installed for short duration cut-over at the termination points.