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How to Observe Field Progress and Punch List for Structured Cabling Premise Projects – A Guide for Training and Education

Introduction

The role of a design consultant providing any subject matter expertise and discipline service to real estate development projects is three-fold:

1. Provide advisory subject matter expertise within the confines of the project scope to help the client make informed decisions.
2. Produce contract/construction documentation coordinated to a committed level (usually LOD 300/350) with other, relevant project trades, that captures a complete scope such that a contractor can buy-out and install the project.
3. Provide oversight and troubleshooting guidance during the construction process so that the project outcome is functionally appropriate, aesthetically aligned with the architectural intent, and positioned for the best possible operational experience for the owner.

During the Construction Administration phase, the consultant will typically perform Field Observation walkthroughs to survey progress and memorialize work outstanding or to be corrected, either due to unapproved scope deviation or technical deficiency. As a project nears completion, the consultant will typically perform Punch List walkthroughs to document items of work that should be corrected or completed in order to approve project close out.
Both tasks should encompass the same principal methodology; evaluate the completeness of the project scope and the technical compliance of the installed technology solutions.
Technical compliance includes the following:

1. The installation should adhere to all relevant code mandates of the Authority Having Jurisdiction (AHJ) i.e., the National Electric Code (NEC) and International Building Code (IBC). *Note that each AHJ has the authority to adopt different versions of relevant code documentation at its discretion, except for reverting back to older code versions.*
2. The installation should comply with industry-recognized best practices as described in the Telecommunications Industry Association (TIA), International Organization for Standardization (ISO), Building Industry Consulting Services International (BICSI), etc., wherever possible, except in situations where constructability issues prevent compliance but do not compromise technical performance and/or integrity of the solution.

3. The installation must comply with the manufacturer guidelines for a complete and functional installation. To this end, manufacturer requirements must be satisfied to certify and warranty a project installation. This is a critical component of *MOST* project close out milestones. **Note – exceptions may be made where ownership does not mandate a warranty requirement.*

When performing a field observation or punch list survey, the following steps are good practice to ensure a comprehensive review of the project is completed and documented in an efficient and effective manner:

1. Confirm the project area to be surveyed, noting if access will be required for coordination with the contractor, property manager or end-user on site. Notify in advance and confirm access prior to attending the site walk.
2. Confirm an understanding of required protective equipment i.e., hard hat, steel toe boots, neon vest and/or eye protection necessary to walk the site.
3. Review the relevant project documentation - primarily plans and specifications - to confirm understanding of the intended installation end-state.
    a. Note that a conformed set of relevant addenda, bulletins and sketches should be used rather than a single milestone issuance.
    b. Note that scope is often coordinated/troubleshot through RFIs and is not always captured in sketches or bulletins. Ensure relevant RFI contents are understood for context relating to deviation observed in the field.
4. Prepare a documentation system that will allow for accurate note taking, photo capture, contextual overlay to plans for spatial data, and report generation.
    a. Note that plotting paper drawings, taking photos on a cell phone and writing notes with pen on plan are common legacy practice, but this is not an efficient or particularly effective process.
    b. Leveraging integrated field survey applications such as Fieldwire or PlanGrid via tablet will facilitate a streamlined survey recording and reporting experience, in addition to enhanced accuracy and comprehensiveness.
    c. Ensure that any application leveraged is aligned with the construction project's document management system to simplify report issuance to the relevant parties assigned attention.
5. Create a plan and checklist for what is to be surveyed in what spaces. This mitigates the need to double back to previously surveyed areas due to missed inspection of necessary solution features.

6. For large projects, it's best to divide the survey into multiple area-specific surveys to facilitate a more detailed review of the structured cabling plant.
    a. Note that this is not always feasible due to project schedule, fee structure or various parties needing to coordinate schedules.

The field survey should review all the scope areas and features of the structured cabling plant within all accessible areas of the project. These scope areas typically include the following:

1. **Technology Support Spaces** i.e., Point of Entrance Facilities (PoEs), Telecommunications Rooms (TRs), Main Telecommunications Equipment Rooms (MTERs), Computer Rooms, etc.
2. **Horizontal and Backbone Pathways**
3. **Fiber Optic & Copper Cabling Plant**
4. **Work Area Outlets**
5. **Periphery Device Outlets** i.e., Wireless Access Points (WAPs), Security Cameras, IP-Based Intercoms, etc.
6. **Operational Technology (OT) Interface Locations** i.e., Lighting Control Panel Outlets, Elevator Control Panel Outlets, Access Control Panel Outlets, Building Management System (BMS) Panel Outlets, etc.
7. **Grounding & Bonding**

Detailed inspection recommendations for the above scope areas are as follows:

Technology Support Spaces:

a. Equipment Racks/Cabinets
    i. Are they properly assembled?
    ii. Are they located in the correct locations/orientations?
    iii. Are clearances acceptable for installation and maintenance?
    iv. Are they permanently affixed to the concrete slab or raised floor?
    v. Are they bonded to overhead cable tray or directly to primary/secondary bonding busbar?
b. Patch Panels, Fiber Enclosures & Wire Management
    i. Are patch panels, enclosures and horizontal wire managers installed in the coordinated locations?
    ii. Are patch panels the correct size and configuration?
        1. # of RUs
        2. Angled vs. Flat
        3. Modular vs. Punch down

iii. Are the fiber enclosures correctly sized and configuration?
    1. # of RUs
    2. Adapter Panel vs Splice Tray
iv. Are they clearly labeled in compliance with the specified format?
v. Are horizontal & vertical wire managers the correct size and configuration?
    1. single-sided vs dual-sided
vi. Do wire managers have capacity for Day 2 growth?

c. Overhead Ladder Rack or Cable Tray
    i. Is it installed with the correct support mechanism?
        1. Strut or trapeze suspended from threaded rod?
        2. Cabinet/rack standoffs?
        3. Support spacing intervals?
    ii. Properly bonded to the primary/secondary bonding busbar?
    iii. Splice and fitting locations equipped with bonding jumpers?
    iv. Proper clearance both top, bottom and sides of pathway for access?
    v. Equipped with proper accessories for strain relief, bend management and cable organization?
    vi. Coordinated with pathway heights for cable ingress/egress?
d. Grounding & Bonding
    i. Is the Primary/Secondary Bonding Busbar (PBB/SBB) installed?
    ii. Is the PBB/SBB properly sized in compliance with the specification?
    iii. Is the Bonding Backbone Conductor (BBC) tapped and bonded to the PBB/SBB?
    iv. Are all metallic equipment items bonded to the PBB/SBB?
e. Cabling Plant (*Within Technology Spaces*)
    i. Do outside plant cables transition to indoor rated cables within 50’ of the point of entry?
    ii. Does all cabling meet the specified performance level and brand?
    iii. Does all cabling appear to be in good condition?
        1. free from kinks
        2. abrasions
        3. coating of paint or other materials
    iv. Is cabling bundled and dressed in a neat and organized manner?
    v. Do terminations appear to be completed in a neat and consistent manner?

vi. Are bend radii properly maintained?

f. Horizontal/Vertical Pathways
    i. Are fill capacities of pathways at or within acceptable ranges?
        1. 40% for conduit
        2. 50% for cable tray or slot penetrations
    ii. Are penetrations through fire-rated partitions and slab properly fire stopped?
    iii. Is installation coordinated with other trades for accessibility on both Day 1 and Day 2?
    iv. Do conduits have bushings installed?
    v. Are conduits capped, if required?

Note that some projects will have unique spaces such as Data Centers (DCs), radio equipment rooms, Security Equipment Rooms (SERs), Network Operation Centers (NOCs), etc. that require equipment room-level attention as well and may have unique features, specific to that project.

Horizontal and Backbone Pathways:

a. Incoming Service Pathways
    i. Are the correct quantity of pathways and points of entry present?
    ii. Are the pathways clearly labeled with an appropriate designation?
    iii. Are the pathways entirely enclosed between the foundation penetrations and the Telecommunications Service Entrance Facility (TSEF aka POE)?
    iv. Are penetrations through fire-rated partitions fire stopped?

b. Backbone Riser Pathways
    i. Are the correct quantities of pathways and riser shafts present?
    ii. Are the pathways clearly labeled with an appropriate designation?
    iii. Are the installed pathway types in compliance with the coordinated design?
    iv. Are the risers accessible for installation and maintenance?
    v. Are pull boxes installed every 50 vertical feet within continuous enclosed pathways?
    vi. Are strain relief fasteners provided at anchor points within the accessible pathway areas?
    vii. Are bushings installed on the end of any metallic conduits/sleeves?

viii. Are the slab penetrations fire-stopped?
ix. Are appropriate transition pathways to termination equipment installed?

c. Horizontal Pathways
    a. Are the pathways clearly labeled with the appropriate designation?
    b. Are pathways clear of any obstructions that would prevent installation and maintenance?
    c. Are pathways accessible on both top and side clearance at regular intervals appropriate for pulling and dressing cable?
    d. Are j-hook/cable strap pathways installed such that cabling is always supported by approved pathway types and intervals no greater than 5' per TIA?
    e. Are conduit pathways installed with pull boxes every 100' linear feet of continuous run or after 180 degrees of cumulative bend?
    f. Are conduits/sleeves/fire-rated re-enterable pathways within the 40% maximum fill capacity dictated by the NEC?
    g. Are cable tray pathways within the 50% maximum fill capacity recommended by TIA?
    h. Are cable tray pathways supported at required intervals no greater than the load they are designed per manufacturer's recommended load rating?

Fiber Optic and Copper Cabling Plant:

a. Fiber Optic Cabling
    a. Are the correct strand counts and performance level (OM3, OM4, OS2) installed?
    b. Are the cables rated for the environment in which they're installed?
        i. Outside Plant
        ii. Indoor/Outdoor
        iii. Plenum (CMP)
        iv. Riser (CMR)
    c. Are the cables armored or distribution (non-armored) in compliance with the design intent?
    d. Are the observable cables in good condition?
        i. free of abrasions
        ii. kinks

iii. paint

e. Are observable bend radii in compliance with the manufacturer's guaranteed minimum?
f. Are the connector styles in compliance with the design intent?
    i. LC/SC/ST/FC
    ii. Duplex vs. Simplex
    iii. Splice-On vs Mechanical
g. Are the termination configurations in compliance with the design intent?
    i. splice cassettes
    ii. adaptor panels
h. Are cables neatly dressed and labeled in compliance with the specified labeling scheme?

b. Copper Cabling (*Throughout project area*)
    a. Are the correct performance levels provided for the designed programmatic intent?
        i. Cat6 vs Cat6A, etc.
        ii. Station vs WAP, etc.
    b. Is the construction aligned with the design intent?
        i. Unshielded Twisted Pair (UTP) vs Shielded, etc.
    c. Are the cables rated for the environment in which they're installed?
        i. Outside Plant
        ii. Indoor/Outdoor
        iii. Plenum (CMP)
        iv. Riser (CMR)
    d. Are the observable cables in good condition?
        i. free of abrasions
        ii. kinks
        iii. paint
    e. Are observable bend radii in compliance with the manufacturer's guaranteed minimum?
    f. Are cables neatly dressed and labeled in compliance with the specified labeling scheme?
    g. Is separation from sources of EMI maintained throughout?
        i. Power wiring
        ii. Motors
        iii. Electric Panels

h. Are the connectors in compliance with the design intent?
    i. Performance Level (Cat6 vs Cat6A)
    ii. Manufacturer Sub-Brand
    iii. Standard vs Field-Terminable
    iv. UTP vs Shielded
i. Are any terminated jacks, not installed in final mounting positions concealed within plastic wrap for protection?

Work Area Outlets:

a. Are Work Area Outlets (WAOs) provided in the correct port configurations at the coordinated locations? *Note – *Coordinated locations are typically shown on the architectural plans.*
    i. 2-Port, 3-Port, 4-Port, 6-Port, etc.
b. Are WAOs located within the recommended proximity to power outlets where applicable?
    i. Within 3 ft
c. Is furniture outlet cabling neatly dressed within the manufacturer provided cabling raceways?
d. Are outlets clearly labeled with machine printed labels in the specified format?
e. Are faceplates properly mounted to walls, furniture or floor boxes so that they are permanently secure?

Periphery Device Outlets:

a. Are Wireless Access Point (WAPs) outlets installed in the coordinated locations?
b. Are service loops provided in sufficient lengths that the network integrator can relocate outlets as needed during WAP deployment?
c. Are Security Camera (CAM) outlets installed in the coordinated locations?
d. Are data outlets for AV systems installed in the coordinated locations?
e. Are outlets visibly accessible for patch cord installation and maintenance?
f. Are biscuit box outlets or direct-attach, field-terminable plugs provided in compliance with the design intent?
g. Are any terminated jacks, not installed in final mounting positions concealed within plastic wrap for protection?

Operational Technology (OT) Interface Locations:

a. Are control panel outlets located in the coordinated locations?
    i. Ideally within dedicated control panels?
    ii. Are 600V patch cords provided for code compliance where mixing Class 2 or 3 wiring with Class 1 wiring where appropriate physical separation is not provided?
b. Are field-level sensor or control devices provided with direct-attach or biscuit box outlets in the coordinated locations?
c. Is cabling within electrical spaces concealed within conduit for the entire run to the outlet?
d. Is the outlet enclosed within a grounded, metal backbox or enclosure?
e. Are outlets within spaces that may be subject to hazardous or corrosive materials exposure rated for such use?
f. Are outlets and cabling within environments that will impose high levels of Electro-Magnetic Interference (EMI) where recommended levels of physical separation from EMI sources can not be maintained provided with a cabling solution that can mitigate the interference?

Grounding & Bonding:

a. Has the Primary Bonding Busbar (PBB), typically located within a Main Telecommunications Equipment Room (MTER), been verified that it is connected to the Building Electrode System?
b. Are all Secondary Bonding Busbars (SBBs) connected to the PBB?
c. Are bonding backbone conductors sized in accordance with the design?
d. In buildings with multiple telecom risers, are grounding equalizers installed on every 3rd floor and at the top floor that bonding busbars are present?
e. Are all bonding conductor taps terminated with an irreversible compression type connector approved for use in bonding?
f. Are all metallic equipment terminations completed with appropriate bonding lugs and conductors, or factory-made bonding jumpers?

Undoubtedly, there are addition technical and design criteria that could be added to the above list. It is not intended to be exhaustively comprehensive, but rather the represent the vast majority of scope survey that would validate a proper installation. Due to the extent of survey that should be completed at progressive intervals during installation, it is recommended that

the consultant recruits the structured cabling solution rep to attend site surveys, when possible, to provide commentary on technical features specific to the solution.
Lastly, it is worth considering some real-world examples of what can be encountered in the field that may have implications for various parties involved in design, construction and ownership.

Scenario 1 – While performing a field survey of installation progress, the consultant realizes that a design error was not captured during QA/QC and has been installed in a manner that is inappropriate as a result. *Example: Flat patch panels were called for in the design, but the owner's standards clearly state a requirement for angled patch panels.* There are a few steps the consultant should take to set up a constructive resolution:

a. Consult internally with the Principal in Charge (PIC) prior to notifying the project team.
b. Identify a plan that satisfies the owner's requirement while minimizing the cost and schedule impacts to the project to the greatest extent possible.
c. Notify the project team through the appropriate communication channels of the issue and the proposed resolution.
d. Prepare to work through impacts to the project with the contractor and greater project management team, within the appropriate confines of the consultant role, to smooth the resolution process.
e. Note: *Though there may be hurt feelings and hardship on the parts of Ownership or other players, human error should be anticipated by all parties on every project. Strive to be transparent and proactive in helping to solve problems self-created rather than adopting a position of avoidance or deflection.*

Scenario 2 – While performing a field survey, the consultant observes cabling that is pulled in open ceiling space and is being supported by direct contact with plumbing pipes, HVAC duct and other inappropriate building systems/structures. In this case, the contractor has executed an improper installation method and it should be documented for resolution. However, a collaborative posture may achieve the best outcome in this situation and might look like this:

1. Document and photograph examples of the issue in multiple applicable areas for inclusion in the Field Observation Report or Punch List.
2. Flag the contractor down in the field and show him or her the issue, describing how the condition should be resolved.

3. Upon return from the field, provide the contractor with a quick bullet list of items by email, previewing the FOR or Punch List may be emailed so remediation work may begin as soon as possible.
4. Provide the formal FOR or Punch List in as timely a manner as possible so that the contractor and project team are aware of the complete scope of outstanding or remediation work to be performed.

Scenario 3 – While performing a project close-out punch list survey, the consultant notices that the structured cabling solution has been installed with mixed and matched parts from multiple manufacturers and is unsure as to whether a warranty can be issued and whether or not performance will be compromised. The following steps are good practice:

1. Thoroughly document each observable instance, including location for follow up.
2. Review the approved material submittals to verify whether or not the solution was installed as approved of if there is a deviation.
3. Contact the manufacturer's rep for the approved solution to accompany the consultant on a follow up visit to review the installation.
4. Have the rep advise as to whether there are any issues with the installation that might impact performance or certification.
5. Engage the contractor to inquire as to reasoning for the installation condition, assuming the approved submittal provided for an end-to-end solution.
6. Provide written notification, in standalone format rather than within the FOR or Punch List, as to the specific findings, judgement of the rep and reasoning provided by the contractor.
7. Work with the project team to provide a resolution, if any is necessary, that is in the Owner's best interest, keeping in mind schedule and cost impacts to the project.

The content provided herein is intended to be educational, such that young consultants and their managers can refer to it for training and guidance. It is not intended to reflect the scope a consultant is contractually obligated to perform, nor is it entirely comprehensive for all project scopes. It should be reiterated, that because the content of a field observation survey or punch list is multifaceted (scope compliance, code/standards compliance, manufacturer's compliance and quality assurance); it is often of value to enlist the service of the approved solution's manufacturer's representative to assist with these tasks. The provides for a comprehensive, efficient and effective review of construction progress and completion.