International Journal of Emerging Research in Engineering and Technology
Pearl Blue Research Group | Volume 7 Issue 1 PP 207-221, 2026
ISSN: 3050-922X | https://doi.org/10.63282/3050-922X.IJERET-V7I1P127

Original Article

From Field Observations to Verified Closeout: An Inspection-to-Closure Method for Architectural QA/QC in High-Rise Construction

Atul Prakash Lad
Florida, USA.

Received On: 13/01/2025 ***Revised On: 13/02/2026*** ***Accepted On: 19/02/2026*** ***Published On: 21/02/2026***

Abstract *- Late-stage closeout problems in high-rise projects often look like isolated punch items, but many behave like repeat offenders: they disappear in a meeting, reappear under a new photo, and consume time precisely when access, sequencing, and inspection windows are tight. This paper documents an anonymized coastal Florida case study built from six third-party architectural field observation reports with photographs and a consolidated issue log. Rather than treating the dataset as a "defect census," the study treats it as a reliability signal stream produced under periodic, exposure-limited conditions. The contribution is an inspection-to-closure method that turns each observation into a verifiable record that can survive turnover. The workflow standardizes (1) how findings are converted into checkable records, (2) how the controlling reference is selected and locked (permit detail, approved shop/system detail, manufacturer requirement, or consultant-issued field detail), and (3) how closure is granted only when proof matches the risk type. The method organizes closeout into practical closure lanes, supported by a compact "closure evidence pack" that preserves traceability from finding to governing basis to correction to objective verification. The result is not a new code requirement or a new material. It is a repeatable control process that reduces ambiguity, limits reopen, and converts field observations into defensible closeout outcomes.*

Keywords *- Closeout Control, Architectural QA/QC, Inspection Workflow, Verified Closure, Governing Basis, Evidence Pack, Closure Lanes, Interface Coordination, Water Management At Openings, Guard Gap Verification, Door Operability Check, Turnover Documentation.*

1. Introduction

In high-rise construction, the most consequential defects often begin as the most ordinary ones. A joint that is almost sealed, a drainage path that is almost clear, a guard detail that is almost compliant, or an interface that is almost aligned. These conditions rarely look dramatic in the moment, but they occur at the exact locations where building performance and compliance are decided: the handoffs between systems, trades, and tolerances.

This paper presents an anonymized coastal Florida high-rise case study built from six third-party architectural inspection reports with photographs and a consolidated issue log. Within this dataset, late-stage architectural findings are disproportionately concentrated at system interfaces rather than in the middle of isolated components. The observed issues are not limited to waterproofing. They repeatedly fall into three operational risk families that shape closeout outcomes:

- Performance pathway defects: discontinuities and blocked drainage routes at openings and edges that allow water to enter, collect, or migrate.
- Compliance-trigger defects: architectural conditions that activate code or accessibility nonconformance, even when the installation appears substantially complete [1], [3], [11], [12].
- Fit and coordination defects: detail-to-field drift and tolerance stack-ups that create misfits requiring deliberate resolution rather than cosmetic patching.

The project consequence of these interface defects is rework and closeout disruption. Late-stage corrections compete with the most schedule-sensitive phase of delivery: finishing completion, inspection readiness, commissioning activities, and turnover preparation. When an issue is identified late, the corrective work rarely remains local. It typically requires re-access, selective removal, cross-trade coordination, and documented verification. In practical terms, the earlier a defect is translated into a decision-ready action with clear closure proof, the lower the cost of resolution. The later it is discovered, the more it behaves like a multiplier [30], [31].

The contribution of this paper is a practical inspection-to-closure method that converts periodic field observations into reliable closeout control. Instead of treating inspection comments as standalone punch notes, the method treats each observation as a controlled risk item that must be driven to verified closure through: (i) classification by risk mechanism, (ii) assignment of an appropriate resolution path (field correction versus design revision), and (iii) objective closure evidence. This addresses a persistent practice gap: project teams routinely generate inspection reports, but they less consistently convert those reports into an auditable, repeatable closure workflow that prevents "closed on paper" outcomes at turnover [8].

This framing keeps the case study honest. The exact items are project-specific, but the mechanisms are transferable. Interfaces create repeatable risk, and disciplined closure is the difference between "observed" and "resolved."

2. Inspection Program Definition and Boundaries

2.1. Program Definition

This case study is based on a construction-phase, third-party architectural QA/QC field observation program executed through periodic site visits and documented in recurring photographic inspection reports and a consolidated issue log. The program's stated purpose is to identify observed deviations from the governing permit/bid documents and to document those observations for coordination and corrective action by the project team [1], [3], [8].

2.2. Scope and Limitations

The inspection program has explicit constraints that govern how its findings must be interpreted:

- *Visual and exposure-limited:* Findings are derived primarily from visual observation of building elements that are exposed and accessible at the time of the visit.
- *Periodic, not continuous:* The consultant is not stationed on site full time; therefore, the program cannot observe all construction activities or detect all conditions that may exist.
- *Non-exhaustive:* The inspection effort is not intended to verify every location, component, or installation condition across the building.
- *No design-adequacy evaluation:* The program does not evaluate the adequacy of architectural design solutions; it documents observed field conditions relative to the governing documents and referenced criteria.
- *Not a warranty or guarantee:* The inspection reports are not intended to function as a guarantee that the work is defect-free or fully compliant in all respects.
- *No follow-up included by default:* Follow-up inspections of listed items are not included as a base service unless separately authorized, which limits direct third-party confirmation of corrective work.
- *Not a substitute for statutory/code-defined roles:* The program does not replace the responsibilities of the A/E of record or other required inspection roles (e.g., threshold or special inspection services) [1], [8].

2.3. Implications for Case-Study Method and Evidence

These boundaries define the operating environment that the paper addresses. Because the inspection program is periodic and exposure-limited, the reports should be treated as structured risk signals, not as a complete inventory of all deficiencies present in the building. The case-study method therefore focuses on what can be executed reliably under these constraints: converting documented observations into decision-ready corrective actions and verified closures through a consistent tracking and evidence protocol. In this framing, the value of the inspection program is realized not by assuming perfect detection, but by ensuring that each documented observation is driven to an objective closeout outcome rather than remaining an unresolved narrative entry.

3. Dataset & Evidence Package

3.1. Data Sources

The case study evidence is drawn from two primary artifacts generated during construction [8]:

- *Architectural inspection reports (AR-01 through AR-06):* A recurring series of third-party construction-phase architectural inspection reports containing narrative observations and photographic documentation of observed conditions during periodic site visits.
- *Consolidated observation log:* A structured tracker that aggregates the inspection observations into record-level entries for coordination and closure, including columns that capture responsibility, required action, responses, and status.

Together, these artifacts provide both (i) field evidence (photo-backed observations) and (ii) execution evidence (how observations were routed, addressed, and tracked toward closure).

3.2. Unit of Analysis and Record Structure

The unit of analysis in this paper is a single observation record, defined as one discrete, documented field condition identified in the inspection reporting cycle and represented as one row in the consolidated log [30], [31]. Each record contains, at minimum, the information required to support closeout execution:

- Location/context sufficient for field identification and trade coordination
- Observed condition (concise description of the deviation or deficiency)
- Responsible party or trade interface implicated by the item
- Response and required action (what must occur for resolution)
- Disposition status (open/closed or equivalent progress state)

This structure allows the paper to treat observations not as isolated comments, but as actionable records suitable for systematic closure.

3.3. Evidence Normalization for Research Use

To enable consistent analysis without inflating the dataset or introducing subjective narrative, the raw observation records are normalized using a minimum viable tagging approach:

- Risk Family Tag: Performance | Compliance | Fit/Coordination

- Closure Evidence Tag: Photograph | Re-inspection confirmation | Design/A/E response | Vendor/manufacturer confirmation (as applicable)

These tags are intentionally minimal. They preserve the integrity of the original observation language while enabling repeatable grouping and defensible interpretation of how issues are progressed to closure.

3.4. Data Interpretation Boundary

Consistent with the inspection program limitations established in Section II, the dataset is not interpreted as a complete census of all defects present in the building. It represents a set of documented, visible, construction-phase observations captured during periodic visits and preserved through a structured logging mechanism. The analytical intent is therefore not to claim total defect prevalence, but to demonstrate how observed issues can be translated into a repeatable inspection-to-closure workflow grounded in documented evidence.

4. Defect Mechanisms and Risk Pathways

This section presents the case-study findings by organizing the inspection observations into a small number of repeatable defect mechanisms. The purpose is not to list comments, but to convert each observation into an understandable technical story: the intended function of the affected component, the deviation observed, the risk pathway created, and the minimum closure condition required to confirm the risk is removed. The findings are grouped into three categories, presented in the order that supports field execution: (A) performance pathway risks, (B) compliance-trigger risks, and (C) fit and coordination risks. For each category, key construction terms are defined in plain English at first use so both technical and non-technical readers can follow the logic without prior field experience.

4.1. Performance Pathway Risks (Water and Durability)

This subsection presents the performance-pathway mechanisms documented in the architectural field observations. "Performance" is treated in a practical way: the building must shed, drain, and contain water predictably at openings, wet areas, edges, and transitions [6], [18]. The findings are organized as mechanisms with consistent structure so a reader can follow both the field condition and the physical consequence without prior construction experience.

4.1.1. Water-Control Layer Discontinuity at Openings and Wet-Area Thresholds

A waterproofing membrane (or liner) is the layer intended to keep water on the "wet side" of an assembly, preventing moisture from reaching substrates, framing, and concealed cavities [18], [20]. At door/storefront thresholds and shower transitions, this layer must remain continuous at the lowest edge, where water naturally concentrates.

Field signature: The reports identify multiple opening and wet-area conditions described as non-compliant with the permit drawings. For balcony sliding glass doors, the waterproofing is noted as not extended under the sill/track, even though the architectural detail calls for the waterproofing to run continuously under the sill/track and terminate at the aluminum angle (see figure 1). For master bath shower storefront sills, the reports note that the required "step" is not provided and the water-resistant membrane (pan) is not extended over the storefront sill, even though the architectural detail calls for the step and for the pan to extend over the sill and terminate at a continuous aluminum angle. This condition is illustrated by the intended step-and-pan termination detail and a representative field condition (see Figures 2–3). In addition, some master bathroom areas are documented with the waterproofing/liner not continuous and not turned up the vertical wall in portions of the wet-area build, which the reports flag for correction before tile and wall finishes conceal the condition.

Risk pathway: Openings and wet areas are not expected to stay perfectly dry. They are expected to manage incidental water through continuity and positive drainage [6], [18]. When the water-control layer is interrupted at the low edge, water can migrate behind finishes through gravity and capillary action. Once moisture is in concealed zones, the scope typically expands into selective removal, rebuild, and re-verification at an interface that is already schedule-sensitive late in the project.

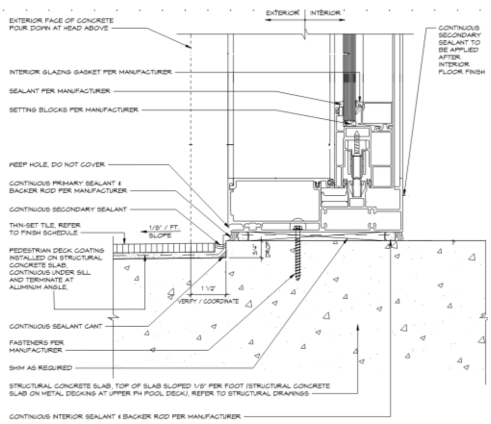

Fig 1: De-identified sliding glass door sill detail showing continuous waterproofing under the track and termination at the aluminum angle.

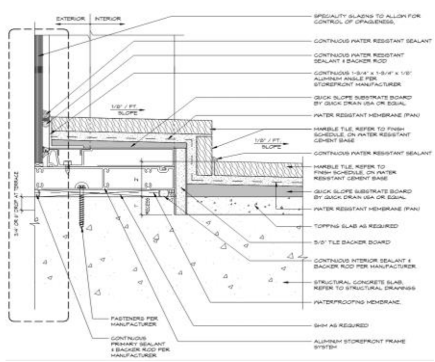

Fig 2: De-Identified Shower Storefront Sill Detail Showing Required Step and Pan Termination over the Sill at a Continuous Aluminum Angle

Fig 3: De-Identified Field Photo Showing Missing Step And Pan Termination At The Shower Storefront Sill Prior To Concealment

Verification target: A continuous water-control layer exists through the low-edge interface, and the threshold transition is built so incidental water is kept on the wet side and directed away from concealed substrates. Closure evidence should be objective and visual, documenting the rebuilt condition at the critical interface before and after completion.

4.1.2. Drainage Relief Failure at Sliding Door Tracks

Weep holes are small outlets intentionally provided to drain incidental water out of an assembly [6]. They are the designed "relief path" that prevents water from pooling inside tracks and pockets.

Field signature: The reports document sliding glass door track drainage issues where the weep holes are observed clogged with debris. The reports describe this as a condition that prevents rainwater from properly draining and call for continuous cleaning of weep holes throughout, indicating that the drainage relief points are present but not functioning due to blockage at the time of inspection.

Fig 4: De-Identified Field Photo of a Sliding Glass Door Track Showing a Clogged Weep Hole Being Cleared to Restore Drainage

Risk pathway: A blocked outlet turns a drainage system into a container. When water cannot exit through the designed weep path, it accumulates in the track pocket and can migrate toward adjacent interfaces [6]. The initiating defect can look minor, but the resulting moisture behavior can affect finishes and concealed cavities beyond the immediate track area.

Verification target: Weeps are open and functioning as intended, and the track assembly is in a condition that permits water to exit rather than remain trapped. Closure evidence should visibly confirm the outlet condition (clear, unobstructed weeps) and the track pocket cleanliness.

4.1.3. Internal Water Collection in Hollow Guard/Railing Posts

Many railing systems use hollow metal posts that must be closed at the top to prevent water entry [26], [27]. A cap or cover plate is a simple component, but it controls whether the post behaves as a protected exterior element or an open water container.

Field signature: The reports document railing installation conditions where the architectural drawings and glass railing shop drawings specify a cover plate over railing posts, but posts are observed without cover plates. The reports explicitly note that the top of the hollow posts remains open, allowing rainwater intrusion into the posts, and recommend installing covers as quickly as possible to avoid leaving the post interior exposed. The open-post condition creates active water entry and internal collection, not merely a cosmetic omission.

Risk pathway: Open hollow posts allow water to enter and remain inside the cavity. Trapped internal moisture accelerates corrosion mechanisms from within, degrades base connections over time, and can create staining or leakage at penetrations [26], [27]. The issue is durability-driven and can persist silently even when exterior surfaces appear acceptable.

Fig 5: De-identified photo of a hollow metal railing post showing the open top condition (no cap/cover plate)

Verification target: Posts are closed in a durable manner so water cannot enter the cavity, and the closure is permanent rather than temporary. Closure evidence should document the completed post condition in a way that clearly demonstrates the cavity is no longer exposed.

4.1.4. Planter Waterproofing Termination Weakness

Planters are controlled wet zones. Their liner/membrane, drainage layer, and root barrier are intended to contain water and relieve pressure while protecting the building structure [23], [24]. The termination at the top edge is a critical boundary because it defines where the wet zone ends.

Field signature: The reports document planter waterproofing conditions described as not in compliance with the architectural planter detail. The detail requires the drainage board (a rigid sheet that creates a drainage space against the wall) and root barrier (a protective sheet that resists root penetration) to be installed up to the full height of the planter wall, but the observed condition shows these components terminating approximately 4 to 6 inches below the top of the planter wall. The same detail calls for a flashing condition at the top of the wall, but the reports describe a termination bar (a metal strip used to mechanically fasten a membrane edge) installed in lieu of that flashing approach, with missing fasteners at pre-drilled holes, indicating an incomplete or improperly secured termination condition at a critical edge [23], [24].

Risk pathway: If drainage and protection layers terminate short, water behavior changes at the top zone: hydrostatic pressure (water pressure from standing water) can increase against the liner, and water can migrate behind an incomplete termination boundary [23]. Missing or incomplete edge securement is not cosmetic because the termination must remain restrained to maintain continuity over time, especially in a zone exposed to repeated wetting.

Fig 6: De-Identified Photo of Planter Liner at the Top Termination Zone

Verification target: The termination condition is complete and secured so that the wet zone remains fully contained and protected up to the intended boundary. Closure evidence should document continuity and edge restraint at the termination zone and confirm the intended layer stack is present where required.

4.1.5. Roof Drainage Interface Failure

Roofs are designed to move water quickly to controlled discharge points. Scuppers and gutters are drainage components that collect and route runoff; when incomplete, they create longer wetting durations at seams and interfaces and can produce uncontrolled discharge paths on wall surfaces [11], [12], [23].

Field signature: The reports document roof drainage control conditions centered on missing collection/discharge elements and incomplete scupper interfaces. Scuppers are wall openings that allow roof runoff to drain out through a parapet. At an upper roof low point, gutters are noted as not observed where the architectural roof detail indicates they should be provided. At stair roofs, gutters and downspouts are noted as not observed at scupper locations, and the reports also record surface stains consistent with ponding at and around scupper openings (indicating insufficient slope at the interface). In addition, the reports document gaps around the perimeter of scuppers that allow rainwater to penetrate at the opening and stain the wall surface directly below, indicating uncontrolled discharge and incomplete edge sealing at the scupper interface.

Fig 7: De-Identified Stair Roof View Showing Scupper Discharge Area Without Gutters/Downspouts At The Parapet Interface

Fig 8: De-Identified Close-Up at a Scupper Opening Showing Staining/Ponding Indicators Consistent with Insufficient Slope at the Drainage Interface

Risk pathway: When roof runoff is not captured and directed, water remains in contact with vulnerable interfaces longer than intended, increasing the probability of leakage at terminations and penetrations [23], [24], [25]. Uncontrolled discharge can repeatedly wet wall assemblies, stain finishes, and drive moisture into joints not designed for persistent flow. Scuppers are especially sensitive because they concentrate multiple transitions into a small opening.

Verification target: Runoff control is complete and continuous at the drainage interface so water is collected and discharged through the intended path, not across unprotected surfaces. Closure evidence should clearly show the completed discharge interface condition and the absence of obvious uncontrolled flow indicators at the scupper edge.

Fig 9: De-Identified Photo Showing an Unsealed Gap at the Scupper Perimeter, Creating a Leakage Path That Stains the Wall Surface Below During Rain Events

4.2. Compliance-Trigger Risks

Some architectural observations become compliance issues the moment they cross a measurable threshold [1], [3]. In other words, the item is no longer "quality" or "finish." It becomes a condition that can fail inspection because the requirement is objective: a gap is either within the allowable limit or not; a door is either operable within the allowable force or not. This subsection documents the compliance-trigger mechanisms captured in the field observations.

4.2.1. Guard Opening Limitation Nonconformance

A guard is the protective barrier at balconies, stairs, or elevated edges intended to prevent falls [2]. Guards are also structural elements required to resist minimum design loads [2]. Many codes limit how large an opening can be in a guard so a small child cannot pass through [1], [3]. The common test concept is a "sphere rule," meaning a ball of a 4 inch diameter should not be able to pass through the guard opening [3].

Field signature: The reports document a guard/glass condition where the measured gap between the glass guard panel and the adjacent wall is 5-1/4 inches and is identified as not acceptable relative to the maximum opening limitation used for guards [3]. The observation is presented as a dimensional compliance issue, not a subjective finish concern.

Fig 10: De-Identified Field Measurement Showing a Guard/Glass-to-Wall Gap Exceeding the 4-in. Maximum Opening Criterion used for Guards

Risk pathway: Guard opening limits exist because the hazard is physical and immediate. When an opening exceeds the allowable dimension, the guard may no longer provide the intended fall-prevention performance for children [3]. This is a compliance trigger because it is evaluated by measurement, and it typically cannot be "interpreted away" during closeout.

Verification target: The guard opening at the identified interface meets the governing maximum opening limitation for guards in the applicable code criteria used by the project [1], [3]. Closure evidence should include objective confirmation of the final dimension at the gap location (a measured field verification) documented in a way that is unambiguous.

4.2.2. Door Operability Force Exceedance:

Door operability is a compliance topic when doors are part of the path people use to exit a space. Codes and accessibility criteria often limit how much force is allowed to open certain doors because excessive force can prevent safe and equitable use, especially during emergency egress or for users with limited strength [1], [3].

Field signature: The reports document a sliding glass door that requires more than 30 pounds of force to open. The observation is explicitly tied to life-safety intent by noting that this condition conflicts with the operational expectations shown in the life-safety planning for egress.

Risk pathway: Excessive opening force is not a cosmetic nuisance. It is an operability barrier. In daily use, it reduces accessibility and increases user frustration. In an emergency, a difficult-to-operate egress component can delay movement and create unsafe crowd behavior at an opening. This becomes a compliance trigger because operability force can be tested and compared against governing criteria, and it can directly impact inspection outcomes [1], [3].

Verification target: The door operates within the allowable opening-force criteria applicable to its classification and location (egress/accessibility intent as defined by the project's governing requirements) [1], [3]. Closure evidence should be objective: a field verification using a force gauge or equivalent documented measurement that confirms the final operability force.

4.3. Fit and Coordination Risks:

Fit and coordination risks occur when individual components may appear "installed," but the assembled system fails because interfaces were not resolved in the field. These issues are common late in construction because they sit at trade boundaries: glazing meets doors, drains meet structure, and transition details meet real slab elevations [30], [31]. This subsection documents the fit and coordination mechanisms captured in the field observations using the same structure as IV-A and IV-B.

4.3.1. Clearance Conflict Between Railing Glass and Sliding Door Track

A sliding door track is the channel that guides door movement; it requires clear space so the door can travel without obstruction [6]. A glass guard/railing panel must also maintain correct edge clearances to adjacent elements because glass cannot tolerate repeated contact or point impact [26], [27].

Field signature: The reports document a condition where a railing glass panel extends into the sliding door track zone, creating a physical conflict during door operation. The report notes that the glass impacted the door/track area and resulted in shattered glass, and it also documents a temporary blocking condition used in the field to prevent continued contact.

Risk pathway: This is a system-level fit failure. When moving assemblies contact fixed glass, the outcome is predictable: damage, safety hazard, repeated replacements, and rework across multiple trades (glazing, door, railing, and sometimes framing). It also creates a closeout risk because the issue can reappear after "repair" if the underlying clearance geometry is not corrected. The mechanism is not workmanship in isolation; it is incompatible geometry at the interface.

Verification target: The sliding door must operate through its full travel without contacting the guard/railing glass, and the glass edge must maintain a stable clearance to the track/door path. Closure evidence should demonstrate the final clearance condition and confirm that the door operates without interference under normal use.

4.3.2. Drain-to-Structure Conflict at Linear Drains

A linear drain is a long, narrow floor drain commonly used in showers [11], [12]. It requires a recessed pocket or cutout so the drain body and slope can fit while maintaining finished-floor alignment [18], [19]. A structural slab contains steel reinforcement (rebar) that provides strength; cutting, exposing, or weakening reinforcement at a drain pocket becomes a structural and durability concern, not just a plumbing adjustment [29].

Field signature: The reports document linear drain locations where the slab recess/cutout was ground deeper than intended, including conditions described as approximately 1 inch into the slab, exposing reinforcement. The reports also describe rebar being exposed and in some cases cut during drain cutout work, and they capture follow-up communication indicating the condition requires an engineered review or confirmation rather than a cosmetic patch.

Fig 11: De-Identified Photo Showing an over-Ground Floor/Drain Recess with Exposed Substrate at the Cutout, Indicating a Depth/Geometry Condition Requiring Controlled Repair Before Reinstating the Wet-Area Build-Up

Risk pathway: This is a coordination failure between architectural finish geometry, plumbing requirements, and structural limits. When the drain pocket is over-cut, the issue is not confined to the shower [29]. It can affect slab capacity, corrosion risk at exposed steel, and the long-term durability of the wet-area edge [29]. It also creates closeout uncertainty because the "fix" must be verifiable and acceptable to the project's engineering requirements, not merely visually covered.

Verification target: The drain pocket depth and geometry must be within the allowable limits for the slab and must not leave reinforcement in a compromised condition [29]. Closure evidence should document the final repaired condition in a way that clearly demonstrates the interface is structurally acceptable and durable in a wet environment (objective confirmation, not visual concealment).

4.3.3. Transition Detail Mismatch at Expansion Joints

An expansion joint is an intentional gap that allows building movement from temperature, shrinkage, creep, or differential settlement [3]. The joint is not a defect; it is a designed movement zone. A joint typically requires a cover or transition system so the gap remains safe and functional while still allowing movement [3]. If elevations or step-down conditions are built inconsistently, the cover system may become impossible to install as intended.

Field signature: The reports document an expansion-joint threshold condition where the step-down/detail is inconsistent between adjacent levels. One level is described as having a 2-inch step-down as shown in the architectural detail, while the adjacent level is described as not having that step-down, leaving insufficient room for the intended expansion joint cover to fit. The observation is framed as a buildability conflict created by inconsistent execution of the transition detail.

Risk pathway: Expansion joints fail when they are treated like ordinary finish transitions. If the cover cannot be installed as intended, the joint either remains exposed (safety and durability risk) or receives an improvised cover that may restrict movement and crack finishes over time. The risk mechanism is repeatable: small elevation differences and inconsistent build control at transitions create downstream coordination failures that are hard to resolve late because multiple finished surfaces are already installed.

Verification target: The transition must be buildable as a system: the movement gap remains functional, and the cover/transition condition fits without forcing or binding. Closure evidence should demonstrate the final installed transition condition and confirm that the assembly provides safe, continuous passage while maintaining the required movement allowance.

The mechanisms in Section IV show that late-stage architectural defects are not random observations, but repeatable pathway failures at trade interfaces. However, identifying a pathway is only the first step; project risk is reduced only when each observation is driven to an objective, verified closeout [30], [31]. Section V therefore presents the inspection-to-closure method used in this case study: a practical workflow that converts field observations into assigned actions, documented evidence, and confirmed closure outcomes.

5. Inspection-To-Closure Method

An architectural field observation is only a moment in time. It captures a visible condition, but it does not prove impact, responsibility, or resolution. In late-stage high-rise work, that gap is where projects quietly lose reliability: an item can be "noted," discussed, even patched, and still return under a different label because the underlying interface, governing detail, or verification step was never settled [30], [31]. This section therefore shifts the paper from identification to control. It documents the inspection-to-closure method used to convert each observation into a verified outcome, with a clear chain of decisions, evidence, and final acceptance before turnover.

5.1. The Inspection-to-Closure Engine

The method used in this case study treats each observation like a controlled handoff, not a casual comment. The goal is simple: the project must be able to answer, for any finding, three questions without debate: What exactly was observed? What detail or requirement governs it? What evidence proves it is closed? To achieve that, every item moves through a consistent chain of custody.

First, the observation is captured in a way that is stable over time: location, photos, and a short description written so another person could find the same condition without the original inspector present. The item is then classified by closure type, because not all findings close the same way. Some are detail alignment issues where the installed condition follows an approved shop or manufacturer system, but the architectural detail is outdated. Some are physical correction issues where a missing component, a damaged element, or an interface gap must be corrected in the field. Others are performance restoration issues where the assembly is conceptually correct, but it fails due to contamination, drift, or incomplete cleaning during finishing.

Next, the governing basis is "frozen" for that item. This is the step that prevents circular arguments. The project identifies what document controls the closure decision: a permit detail, an approved shop drawing, applicable product approval/NOA documentation, a manufacturer installation requirement, or a consultant-issued field detail [7]. If the controlling basis is a revised or consultant-approved detail, that basis is documented and circulated so the correction is not judged against an obsolete drawing. When the item crosses into structural or life-safety sensitivity, the decision basis is routed through the appropriate design professional for confirmation before concealment [8].

Then the correction is executed with a verification mindset. The correction is not treated as "done when installed." It is treated as "done when proved." That proof standard depends on the closure type: for a detail-alignment item, closure requires documented confirmation that the installed condition matches the approved system detail, and that the consultant acceptance is recorded. For a physical correction item, closure requires evidence that the interface is complete, and the triggering geometry is removed (for example, a gap sealed, clearance restored, or the correct component installed). For a performance restoration item, closure requires a functional confirmation, such as a drainage outlet remaining open after cleaning cycles or a door meeting operability expectation after track and roller restoration.

Finally, closure is recorded in the project log in a way that survives turnover. Each item is closed only after evidence is attached and the responsible reviewer confirms that the governing basis and the field condition match. Where closure depends on a revised governing detail, the reference detail is aligned so the same condition cannot be re-flagged as a documentation mismatch.

5.2. Closure Lanes

5.2.1. Scope and Detail Alignment Closures

Some observations look like installation defects at first glance, but the closure is actually a governance task. The field condition is being judged against the wrong reference because the architectural detail is incomplete, outdated, or written for a different assembly than what is approved and installed. This reference mismatch creates “false noncompliance,” and if the team responds by adding material blindly, it can introduce new performance risk [30], [31]. The control is to align three items, in order: (1) trade scope, (2) the governing detail, and (3) the approval record, then close the item using objective confirmation that will still make sense at turnover.

The first alignment case appears in interior wet-area boundaries around bathrooms. The observation flagged discontinuous waterproofing near a vanity zone, but the resolution was not to “patch everywhere.” The project verified what the waterproofing scope actually covered in the intended design and trade scope: the waterproofing was defined as a shower wet-zone system (pan and required vertical turn-ups at wet walls), while the vanity area was not defined as a waterproofed zone in the governing documents. Closure therefore relied on scope clarification and documentation alignment: the project confirmed the intended wet-zone limits and ensured the record reflected what was required to be waterproofed and what was not, preventing unnecessary membrane installation that could later conflict with finishes, adhesives, or sequencing.

A second alignment case occurs at opening interfaces where the observation wording implies a missing condition “per architectural detail,” but the installed condition follows an approved system detail. At sliding door sill/track conditions, the field work used an approved system approach where the waterproofing layer returns upward at the sill zone as an L-shaped turn-up, protecting the transition and blocking water migration into concealed zones [6], [18]. This system-based approach was reviewed and accepted by the waterproofing consultant. Closure anchored the decision to the approved system detail and the consultant acceptance record, and the project then completed the governance correction by aligning the architectural reference detail to the approved condition so future reviews do not re-flag a correctly installed assembly.

Detail note (Figure 12): The section depicts a continuous waterproofing layer applied over the structural slab and turned up at the wall to form a sealed “tub” at the floor-to-wall transition. This turn-up matters because surface finishes are not watertight; water can migrate through grout joints and the setting bed [18], [19]. Above the waterproofing, the detail shows the typical finish build-up: a bond coat (thinset, a cementitious adhesive layer), a mortar bed (a thicker leveling/support layer), and tile with grout at the surface [18], [19]. Where a crack-isolation layer is specified, it should comply with ANSI A118.12 [21]. The controlling intent is straightforward: finishes may get wet, but the waterproofing layer must remain continuous through edges and transitions so that wetness does not become hidden damage.

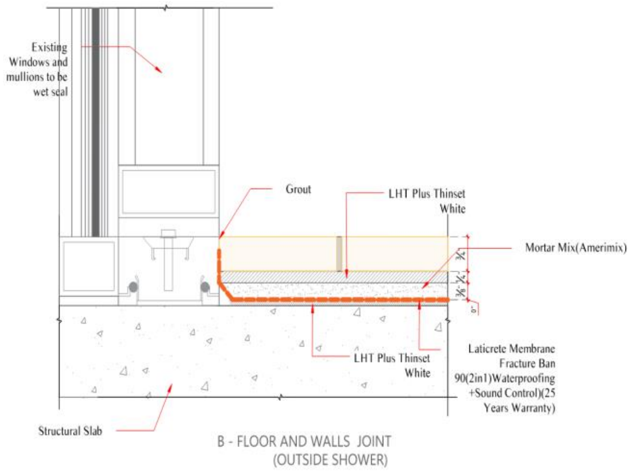

Fig 12: De-Identified Floor-To-Wall Transition Detail Showing Continuous Waterproofing Turned Up at the Wall Beneath the Tile Assembly to Maintain Wet-Area Containment at the Joint

A third alignment case addresses the “step” condition at a shower/storefront sill transition. The issue was treated as high priority because the step and termination geometry govern whether water is kept within the wet zone and directed back to the intended drainage path. The project escalated the observation through internal review and the waterproofing consultant, and the consultant issued a final field detail that resolved the interface explicitly. The glazing team was then directed to coordinate and fabricate brake metal (bent sheet-metal trim used to cover, protect, and visually finish an edge/joint) at the sill and header so the elevation remained consistent while the waterproofing termination and protection logic remained correct [24]. The team field-verified dimensions released the brake metal for fabrication and executed the installation. Closure was declared only after the consultant inspected the finished condition and confirmed conformance to the issued detail, and after the architectural reference was aligned to the verified field condition to eliminate repeat flags driven by outdated details.

Detail note (Figure 13): This detail clearly separates two functions that are often confused in the field: waterproofing of the wet assembly versus sealing of the frame perimeter joints at a sill/track interface. The callouts focus on the joint system where fasteners, snap covers, and frame components create multiple micro-paths for water entry. The detail calls for continuous sealant at critical interfaces and around connection points, with backer rod (a compressible foam rod that controls sealant depth and shape) where required to achieve a stable seal profile [9], [10], [16], [17]. It also references snap covers (clip-on cover pieces that conceal fasteners/anchors) and indicates sealing at those interfaces, so the sill/track joint does not behave like an “open seam.” The key point is practical: even if the wet-area waterproofing is correct behind finishes, an unsealed sill/track perimeter joint can still leak unless the joint is sealed as a system [6], [17].

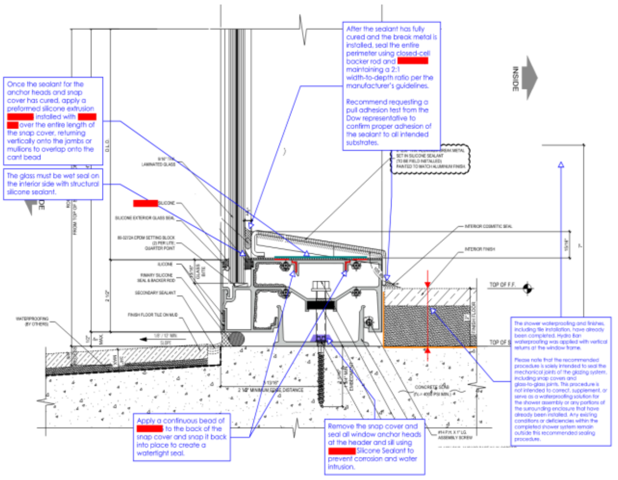

Fig 13: De-Identified Sill/Track Joint Sealing Detail Showing Continuous Sealant and Backer-Rod Placement at Frame Interfaces to Control Water Intrusion at the Perimeter Joint

The same alignment logic applied to exterior wet assemblies such as planters. The observation questioned termination height and edge detailing relative to the architectural detail, but the installed assembly followed the approved system approach reviewed by the consultant, including application continuity and acceptance based on inspection. The project closed the item by anchoring the governing basis to the approved system and acceptance record and then aligning the architectural reference detail to the verified condition, preventing a recurring mismatch between "what is built" and "what the drawings imply."

Detail note (Figure 14): The planter section shows why planters behave like "small roofs" built inside the building. They require a continuous waterproofing liner, a protection/drainage layer, and a root barrier so moisture and roots do not attack the structure or finishes [23]. The detail depicts the liner running across the base and up the planter walls, with drainage and root-protection components carried to the required height so water can drain without pressurizing the wall. The top termination is the most sensitive edge: incomplete terminations (short liner height, missing securement, or incorrect termination hardware) can turn controlled drainage into staining or leakage [23], [24]. The technical theme is continuity, not patching. The liner must remain intact through transitions and terminations to control where water goes.

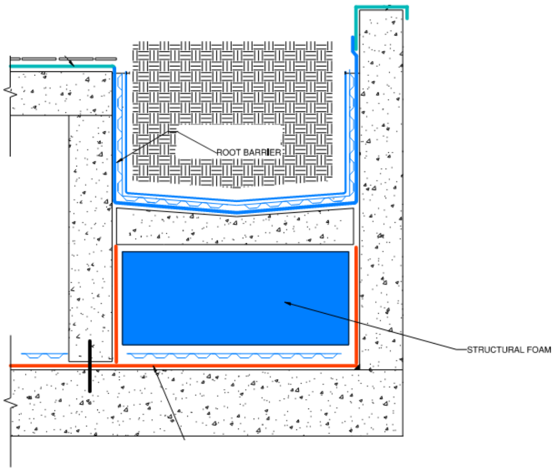

Fig 14: De-Identified Planter Waterproofing Section Illustrating the Liner Turn-Up With Root Barrier and Drainage/Protection Layers, Highlighting the Termination Zone Where Continuity and Secure Edge Restraint Control Leakage Risk

5.3. Performance and Dimensional Verification Closures

This lane closes items only after an objective check confirms restored performance or compliance and that proof is logged. The correction is only accepted when it is paired with a simple, objective verification that can be repeated at turnover. The logic is: fix the condition, then prove the performance or dimension, and record that proof in the closeout log.

For dimensional guard-opening compliance, the closure action was direct: the nonconforming glass panel was replaced with the correct panel, and the final gap was verified against the 4-inch sphere rule (maximum opening 4 inches) [3]. The project treated the measured opening as the closure evidence, not the replacement activity by itself.

For sliding door operability force, the project used a performance-restoration approach [1], [3]. The GC checked door operation across the affected population, cleaned debris from tracks, and replaced or adjusted rollers where friction or damage prevented smooth travel. Verification was functional and repeatable: doors were re-checked after correction to confirm restored operability within the intended opening-force expectation, then the closed status was logged with supporting proof [1], [3].

For track drainage reliability, the project treated weep-hole maintenance as a finishing-phase control. Weep holes are small drainage outlets in the track system; if they are blocked by construction debris, drainage performance collapses even when the door assembly is otherwise correct [6]. The closure method was therefore operational: weep holes were cleared on a routine cadence during final finishing and again during turnover preparation, with additional clearing after dust-generating work. The verification intent was simple: confirm the drainage path remains open at the end of construction conditions, not only on the day the observation was issued [6].

For glass breakage events tied to door travel interference, the closeout had two parts: immediate restoration and recurrence prevention. Shattered glass was replaced promptly to restore the barrier function, and a physical travel limiter (stopper) was installed so door movement cannot re-enter the interference zone [6]. Verification was by operation: full door travel confirmed without contact and without repeat breakage.

5.4. Physical Correction Closures

This closure lane applies when the only honest way to reduce risk is to physically change what is in the field. The control is not an interpretation and not a housekeeping step. It is a targeted rebuild that removes the triggering geometry, restores continuity at an interface, and then gets verified by re-inspection. The writing rule in this lane is simple: state the physical action, state what it restores, and state how closure was confirmed, without re-explaining the original observation.

Open post protection (caps installed). Where railing posts were left open at the top, the closure action was to expedite procurement and install protective caps as early as possible. A cap is a small closure component that seals the post opening so rainwater cannot enter, collect inside the post, and create corrosion or staining risks [26], [27]. The project treated this as an exposure item, prioritized it, and closed it once the caps were installed and the openings were no longer left vulnerable.

Roof drainage geometry correction (slope rebuilt, membrane reinstated). Where roof drainage performance depended on geometry and the substrate had inadequate slope, the corrective action was structural-to-waterproofing sequencing, not surface patching. The project removed the roof membrane locally, corrected the slope by grinding/reshaping the slab to achieve positive drainage, and then reinstalled the roof membrane system over the corrected substrate [22], [23]. This method closes the root problem (water staying in place) rather than merely covering symptoms.

Scupper interface sealing and discharge control. At wall-drain openings (scuppers), two physical controls were treated as essential: a sealed perimeter interface and controlled discharge [23], [24]. The project completed perimeter sealing at the opening interface, so discharge occurs through the intended path, not through edge gaps. Where discharge control elements were required, the missing components were installed so water exits the wall opening in a controlled way rather than washing down finished surfaces. Closure was confirmed after the interface was physically complete and re-checked.

Fig 15: De-Identified Stair-Roof Scupper Discharge Condition after Corrective Work, Showing Added Gutter/Discharge Element to Capture Runoff and Prevent Wall Wetting at the Scupper Interface (Verified During Closeout Re-Check)

Reinforcement exposure at drain cutouts (repair under structural review). Where reinforcement was exposed at linear drain cutouts due to over-grinding, the project treated closure as a durability and structural interface repair, not a cosmetic cover. The closure method included applying a zinc-rich protective coating to the exposed steel before rebuilding the assembly with a new mud bed and then reinstating the waterproofing and tile system [18], [20], [29]. Importantly, this repair approach was reviewed with the project's structural engineer, and the work proceeded after no-objection confirmation [29]. Closure was confirmed after the repaired build-up and finish system were reinstated.

Expansion joint cover buildability (clearance restored with engineer consultation). Where inconsistent step-down geometry prevented the expansion joint cover from fitting, the closure action was to restore the required clearance by selectively removing/chipping the interfering build-up to match the intended step condition [3]. This approach was first consulted with the structural engineer to confirm acceptability, then executed in the field, and closed once the pocket/clearance was restored so the cover could be installed as intended.

Across all physical correction closures, the method is consistent: the project does not "close by explanation." It closes by altering the field condition, so the failure trigger no longer exists, then documenting closure through re-verification that is clear enough to survive turnover [30], [31].

5.5. Verification Rules and the Closure Evidence Pack

Because the observation program is periodic and exposure-limited, preventing reopened items at turnover requires treating closure as an evidence problem, not a conversation problem.

The workflow used in this case study closes items with a simple rule: the proof must match the risk type. Narrative text is never treated as the highest-grade proof. Proof is ranked and attached in a short "closure evidence pack" so a future reviewer can re-check it without the original team present.

5.5.1. Proof matching rule

- Measured compliance (dimension/force) when the requirement is numerical.
- System-detail confirmation when the requirement is "build it like this detail," plus the approval record that makes the detail governing.
- Third-party acceptance when the issue affects life-safety, water management, or durability and was evaluated by the design professional/consultant.
- Before/after photos when the correction is visual and unambiguous.
- Narrative only is acceptable only for administrative closures (e.g., "detail updated," "RFI answered"), and even then it must point to the controlling document.

This hierarchy is what keeps the closeout honest. It prevents the most common failure mode in late-stage QA/QC: a log that says "closed" but contains no durable proof [30], [31].

5.5.2. What the closure evidence pack contains

Each closed item is recorded with the same compact data fields so the tracker stays readable and audit-ready:

- Location identifier (floor/area/room), date, responsible trade
- Observation statement written as a checkable condition (not an opinion)
- Governing reference used to judge the work (permit detail, approved shop drawing, approved field detail, or code anchor)
- Closure action (one sentence)
- Closure proof attached (photo/measurement/sign-off)
- Verification stamp: "verified by GC" or "verified by third-party," with date

This is intentionally lean. The objective is not paperwork. The objective is traceability: anyone can follow the chain from finding → governing basis → correction → proof.

5.5.3. Code and standard anchors:

When an item is controlled by a numeric limit, the closure pack records the limit and the confirmation method.

- Guard openings: closure is confirmed by verifying that openings do not allow passage of a 4-inch sphere as required by the IBC guard opening limitation language [3], [28].
- Door operability: closure is confirmed by demonstrating compliance with the governing operability force requirement for the applicable door type and recording the verification method [1], [3].
- Window/door water-management interfaces: closure is confirmed by documenting that the installed interface follows the governing installation practice for fenestration systems, including flashing continuity concepts that ASTM E2112 is written to cover [6]. When verification requires testing, field guidance and methods such as AAMA 502 and ASTM E1105 (field water), ASTM E331/E547 (water penetration), and ASTM E783 (air leakage) may be used as applicable [5], [4], [13], [14], [15].

The important point is not the citation itself. The point is that the closure proof becomes portable: the measurement or confirmation remains valid even if personnel change.

5.5.4. Detail-governance rule

Where closure depends on an approved revised detail, the reference detail is aligned and logged so the condition cannot recur as a documentation mismatch.

5.6. Transferability and What Makes This Publishable

This case study is not claiming that the same defects appear on every high-rise. The transferable contribution is narrower and stronger: the same closure failures repeat across projects because the closure logic is rarely standardized. Most teams can find issues. Many teams struggle to close issues in a way that survives the transition from "jobsite reality" to "turnover record."

Transferability comes from using the same closure lanes, the same minimum evidence fields, and the same governing-detail alignment step across projects. If another project adopts those three controls, the team gains metrics that a journal reader can recognize as real operational improvement, even without proprietary cost data:

- Closure rate = closed items ÷ total items
- Time-to-close = days from observation to verified closure
- Reopen rate = items reopened ÷ items closed (a direct indicator of weak proof)
- Repeat-pattern index = frequency of the same failure mode across locations (shows whether the fix became a standard)
- Handoff completeness = percentage of closed items with the minimum closure evidence pack attached

These outputs are the bridge between "punch list narrative" and a genuine workflow contribution. They are also why this paper reads as more than a story: it demonstrates a disciplined way to convert field observations into verified closeout, within the realistic limits of periodic observation services.

6. Lesson Learned

Inspection findings do not become valuable when they are written down. They become valuable when the project learns how to close them in a way that cannot be reopened later by a new reviewer, a different document set, or a turnover team that was not present during construction. The core lesson from an inspection-to-closure workflow is that closeout is not only a field activity. It is a coordination and governance activity that must translate field truth into a stable record.

6.1. When the Shop Detail is Correct, the Permit Detail Still Matters

On complex projects, the most time-consuming "repairs" are sometimes not repairs at all. They are mismatches between what is built and what an older permit detail still shows. The field can follow an approved system and still get flagged if the comparison reference is stale or incomplete. In these cases, adding more material in the field can actually create new risk, because it forces the assembly away from the approved system logic just to satisfy an outdated graphic. The practical lesson is that an item stays closed only after the governing reference is aligned. If the shop drawing or consultant-issued detail is the accepted basis, the drawings used for inspection must be updated to match that approved basis, otherwise the same comment will return under a different reviewer.

6.2. "Different Drawings Will Differ" is Normal, but the Project Must Choose One Truth

High-rise work produces overlapping documentation: architectural details, structural drawings, specialty shop drawings, and consultant notes. Differences are not a sign of failure. They are a sign of complexity. What causes rework is not the difference itself, but the absence of an explicit decision about which document governs. The lesson here is straightforward: closeout becomes durable when the record clearly states what the project is being judged against. Without that, even a correct installation remains vulnerable to repeat findings because the reference keeps shifting.

6.3. Escalation is a Predefined Threshold, Not a Mood

A mature project does not escalate everything. It escalates the right items fast. The field reality is that some findings can wait without multiplying risk, while others become expensive if a day is lost. The most reliable approach is to treat escalation as a trigger tied to consequences. Conditions involving water containment at wet areas or openings, life-safety function, structural capacity indicators, or code dimensional limits should be treated as same-day issues, not because they look dramatic, but because delay changes the closure pathway. A good example of a non-negotiable dimensional trigger is guard compliance governed by the 4-inch sphere rule, meaning the opening cannot allow a 4-inch sphere to pass [3]. That is not a "finish" debate. It is a measurable requirement, and it demands measurable closure.

6.4. Geometry is a Requirement, Not a Finish Preference

Many of the hardest problems are not material failures. They are geometry failures: inconsistent step-downs, incorrect slopes, misaligned clearances, or physical conflicts between adjacent systems. Once finishes are installed, geometry cannot be negotiated. It must be rebuilt. This is why the project learns to treat geometry as a first-class requirement that must be verified early, especially before concealment. When slope is wrong, sealing is not a solution. When a step-down is inconsistent, caulking is not a solution. The lesson is not that mistakes never happen. The lesson is that the closure must match the type of problem. Geometry problems require geometry corrections, verified before finishes lock the defect in place.

6.5. Waterproofing and Joint Sealing are Different Functions, and Confusing Them Creates False Confidence

Teams often speak about "waterproofing" as if it is a single activity, but in practice two different protections exist. One is the continuous water-resistant barrier that prevents moisture from entering concealed assemblies behind finishes [18], [20]. The other is perimeter joint sealing at mechanical interfaces where frames, anchors, covers, and joints can create micro-paths for leakage and corrosion [16], [17]. A project can have a correct waterproofing layer and still leak at an unsealed interface. It can also have heavy sealant and still fail if waterproofing continuity is broken. The lesson that keeps findings closed is clarity: the record must communicate what function was being corrected, and why that function, not a generic "more sealant," is the actual closure.

6.6. Interfaces Fail More Often Than Materials, So the Workflow Must Be Interface-Driven

Water rarely enters through the middle of a surface. It enters at transitions: sill zones, terminations, planter edges, scupper interfaces, railing posts, drain cutouts, and frame perimeters. These are edge conditions where small gaps behave like open doors. The practical lesson is that inspection and closure should be organized around interfaces, not trades. When closure is interface-driven, the project stops "fixing the symptom" in one trade and instead closes the pathway across the complete assembly. That is how repeat findings drop, because the same interface does not get reopened under a different scope.

6.7. When Structural Elements Are Touched, Closure Must Shift from "Looks Good" to "Engineer Accepted"

Some findings cannot be closed using cosmetic logic. If reinforcement is exposed, damaged, or cut during a drain cutout or slab adjustment, the question is not whether the surface looks repaired [29]. The question is whether the structural intent remains satisfied. The lesson is that structural-adjacent findings require a different closure lane: engineering review and acceptance, followed by a documented repair that matches that acceptance [29]. This protects the project from unsafe assumptions and protects turnover from inheriting undocumented structural risk.

6.8. Some Findings are Not One-Time Fixes, They Are Recurrence Problems

Certain issues recur during finishing because construction dust, debris, and daily traffic recreate the same condition. Drainage relief points can clog again. Tracks can bind again. Operability can degrade again even after an initial adjustment. If the project closes these items as a one-time repair, they return near turnover when the building is most sensitive to schedule pressure. The lesson is that durable closeout sometimes includes a routine action tied to finishing and turnover, not because the team is careless, but because the environment keeps reintroducing the same failure mode.

6.9. A Finding is Not Truly Closed Until It Can Survive Turnover

The building does not inherit the field conversation. It inherits the record. A finding that is "closed" only in someone's memory is not closed. The strongest closeout packages read like a simple story that a third party can follow: what was observed, what reference governs, what approval chain applies if details changed, what was done, and how it was verified. When that story is complete and consistent, disputes fade, warranty risk drops, and future inspections do not recycle the same comments under new wording [30], [31]. That is the final lesson: closeout is successful when the closure logic is stable enough to outlive the people who executed it.

Taken together, these lessons show that inspection outcomes improve most when closure is treated as a repeatable decision process, not a series of isolated repairs. The inspection log becomes more than a punch list: it becomes a verified narrative that connects field conditions to governing references and durable acceptance. The next section consolidates this method into a concise end-to-end framework and summarizes why it remains reliable under schedule pressure and turnover.

7. Conclusion

High-rise closeout fails for one quiet reason: the project starts treating observations as "items to fix," instead of signals that a system edge is leaking information. When that happens, teams spend effort but lose certainty, and the same condition returns in a new location, under a new photo, with a new argument. That is why late-stage QA/QC cannot be managed as a cosmetic punch list. It has to be managed as a proof-driven closure process.

This paper showed how to turn construction-phase third-party architectural field observations into verified closeout without exaggeration and without pretending the reports are continuous inspection. Standard contract language is clear that site observations are not exhaustive or continuous. Their value is that they surface visible risk early enough to correct it, while decisions and access are still available. The method's practical shift is simple: close each observation by locking the governing basis, executing the correction with the right trade, and documenting closure with evidence that remains defensible at turnover, even after people change.

The results matter because the stakes are real. Rework and moisture-related defects are widely documented drivers of cost growth and claims in building projects [30], [31], [32]. In this context, codes and standards are not academic references; they are measurable thresholds that turn "quality observations" into pass/fail closeout items. Guard opening limits (the 4-inch sphere rule) and door operability criteria (as applicable to the opening type and location) are examples of requirements that force objective closure, not opinion-based closure [1], [3]. Similarly, window and door installation practice emphasizes continuity of water management at openings, including how sill and flashing concepts prevent hidden migration paths [6].

The main takeaway is not that defects exist. It is that defects become repeatable when closure is not governed. When a project separates observations into the right closure lanes, keeps the reference detail aligned with what is approved and installed, and requires stable proof before declaring "closed," the inspection log stops being a list of complaints and becomes a controlled closeout record. That is the difference between finishing a building and finishing with certainty.

References

[1] Florida Building Commission, Florida Building Code, Building, 8th ed. Tallahassee, FL, USA: Florida Building Commission, 2023.

[2] American Society of Civil Engineers (ASCE), Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE/SEI 7-16. Reston, VA, USA: ASCE, 2017.

[3] International Code Council (ICC), International Building Code (IBC), 2021 ed. Country Club Hills, IL, USA: ICC, 2021.

[4] ASTM International, "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference," ASTM E1105-15. West Conshohocken, PA, USA: ASTM International, 2015.

[5] Fenestration & Glazing Industry Alliance (FGIA), "Voluntary Specification for Field Testing of Newly Installed Fenestration Products," AAMA 502-21. Schaumburg, IL, USA: FGIA, 2021.

[6] ASTM International, "Standard Practice for Installation of Exterior Windows, Doors, and Skylights," ASTM E2112-19. West Conshohocken, PA, USA: ASTM International, 2019.

[7] Miami-Dade County, Department of Regulatory and Economic Resources, Product Control Section, "Checklist for the Submittal of: Basic Requirements," revised Sep. 1, 2012. [Online]. Available: https://www.miamidade.gov/building/library/checklists/noa-basic-requirements.pdf (accessed Jan. 27, 2026).

[8] State of Florida, "Permits; applications; issuance; inspections," Fla. Stat. § 553.79 (2025). [Online]. Available: http://www.leg.state.fl.us/ (accessed Jan. 27, 2026).

[9] Dow, "DOWSIL 790 Silicone Building Sealant: Product Data Sheet." [Online]. Available: https://www.dow.com/ (accessed Jan. 27, 2026).

[10] Dow, "DOWSIL 795 Silicone Building Sealant: Product Data Sheet." [Online]. Available: https://www.dow.com/ (accessed Jan. 27, 2026).

[11] International Code Council (ICC), International Plumbing Code (IPC), 2021 ed. Country Club Hills, IL, USA: ICC, 2021.

[12] Florida Building Commission, Florida Building Code, Plumbing, 8th ed. Tallahassee, FL, USA: Florida Building Commission, 2023.

[13] ASTM International, "Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference," ASTM E331-00(2023). West Conshohocken, PA, USA: ASTM International, 2023.

[14] ASTM International, "Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference," ASTM E547-00(2016). West Conshohocken, PA, USA: ASTM International, 2016.

[15] ASTM International, "Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors," ASTM E783-02(2018). West Conshohocken, PA, USA: ASTM International, 2018.

[16] ASTM International, "Standard Specification for Elastomeric Joint Sealants," ASTM C920-18. West Conshohocken, PA, USA: ASTM International, 2018.

[17] ASTM International, "Standard Guide for Use of Joint Sealants," ASTM C1193-16. West Conshohocken, PA, USA: ASTM International, 2016.

[18] Tile Council of North America (TCNA), TCNA Handbook for Ceramic, Glass, and Stone Tile Installation. Anderson, SC, USA: TCNA, 2025.

[19] American National Standards Institute (ANSI), ANSI A108/A118/A136.1-2024: American National Standard Specifications for the Installation of Ceramic Tile. Washington, DC, USA: ANSI, 2024.

[20] American National Standards Institute (ANSI), ANSI A118.10-2023: Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installations. Washington, DC, USA: ANSI, 2023.

[21] American National Standards Institute (ANSI), ANSI A118.12-2014 (R2024): Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installations. Washington, DC, USA: ANSI, 2014 (reaffirmed 2024).

[22] ASTM International, "Standard Specification for Thermoplastic Polyolefin (TPO) Sheet Roofing," ASTM D6878/D6878M-21. West Conshohocken, PA, USA: ASTM International, 2021.

[23] National Roofing Contractors Association (NRCA), The NRCA Roofing Manual: Membrane Roof Systems. Rosemont, IL, USA: NRCA, 2023.

[24] Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), Architectural Sheet Metal Manual, 7th ed. Chantilly, VA, USA: SMACNA, 2012.

[25] SPRI, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems, ANSI/SPRI ES-1-2011. Waltham, MA, USA: SPRI, 2011.

[26] ASTM International, "Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings," ASTM E935-21. West Conshohocken, PA, USA: ASTM International, 2021.

[27] ASTM International, "Standard Specification for Permanent Metal Railing Systems and Rails for Buildings," ASTM E985-24. West Conshohocken, PA, USA: ASTM International, 2024.

[28] International Code Council (ICC), International Building Code (IBC), 2021 ed., Sec. 1015 (Guards). Country Club Hills, IL, USA: ICC, 2021.

[29] American Concrete Institute (ACI), ACI CODE-318-19(22): Building Code Requirements for Structural Concrete and Commentary. Farmington Hills, MI, USA: ACI, 2019 (reapproved 2022).

[30] M. P. Gallaher, A. C. O'Connor, J. L. Dettbarn, Jr., and L. T. Gilday, Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry, NIST GCR 04-867. Gaithersburg, MD, USA: National Institute of Standards and Technology, 2004. doi: 10.6028/NIST.GCR.04-867.

[31] P. E. D. Love and H. Li, "Quantifying the causes and costs of rework in construction," Construction Management and Economics, vol. 18, no. 4, pp. 479–490, 2000. doi: 10.1080/014461900050024897.

[32] P. St. Louis and K. S. Vutukuru, "Mysterious Moisture Marks: Assessment of Water Stains at Window Glazing," International Institute of Building Enclosure Consultants (IIBEC), online exclusive, Aug. 2, 2024. [Online]. Available: https://iibec.org/publication-post/mysterious-moisture-marks-assessment-of-water-stains-at-window-glazing/ (accessed Jan. 27, 2026)