PROCEEDINGS

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Consultant and Contractor Collaboration: Understanding Roles and Responsibilities for Successful Execution of Building Envelope Construction and Rehabilitation Projects

Quinn A. Ferrall, RRC, RWC, RRO, PE, CDT

Davco Roofing & Sheet Metal

4408 Northpointe Industrial Blvd., Charlotte, NC 28216

Phone: 704-817-9788 • Fax: 704-817-8078 • E-mail: qferrall@davco-roofing.com

Christopher W. Giffin, RRC, AIA

Wiss, Janney, Elstner Associates, Inc.

2915 Premiere Parkway, Suite 100, Duluth, GA 30097

Phone: 770-923-9822 • Fax: 770-232-9044 • E-mail: cgiffin@wje.com

Abstract

The roles and responsibilities of the consultant and contractor in the project life cycle are separate and unique but not entirely unrelated. This presentation will review these roles and provide construction document guidelines for establishing expected performance to ensure successful completion of building envelope (BE) projects. BE restoration projects require analysis of the existing systems, which often includes destructive testing and involvement of the contractor in the design development phase. This paper will also provide an introduction to the standard testing procedures and provide additional guidelines for implementation of contractor services in the design development phase, as well as ensuring successful performance through construction.

Speakers

Quinn A. Ferrall, RRC, RWC, RRO, PE, CDT — Davco Roofing & Sheet Metal

QUINN FERRALL is a professional engineer and consultant with over 14 years' experience in design and construction, with a focus on roofing and waterproofing systems. Quinn has been a commercial roofing contractor for over six years with a focus on large commercial projects in the Southeast U.S. He is a licensed professional engineer in North and South Carolina and is a 2001 graduate of The Citadel. Ferrall holds a BS in civil and environmental engineering and received his Master of Business Administration degree (MBA) in 2006.

Christopher W. Giffin, RRC, AIA — Wiss, Janney, Elstner Associates, Inc.

CHRISTOPHER GIFFIN is an associate principal with Wiss, Janney, Elstner Associates, Inc. (WJE) in Atlanta, Georgia. He is a licensed architect and Registered Roof Consultant who specializes in the diagnosis and repair of building envelope problems. With over 20 years of experience, he has been involved with many roofing- and waterproofing-related projects involving both historical and contemporary structures. Notable projects include the Candler Building, The Omni Grove Park Inn Resort & Spa, Fort Benning barracks, U.S. Cellular Field, LSU Tiger Stadium, and Fenway Park.

Consultant and Contractor Collaboration: Understanding Roles and Responsibilities for Successful Execution of Building Envelope Construction and Rehabilitation Projects

ABSTRACT

The roles and responsibilities of the consultant and contractor in the project life cycle are separate and unique, but not entirely unrelated. This paper will review these roles and provide construction document guidelines for establishing expected performance to ensure successful completion of building envelope (BE) projects. BE restoration projects require analysis of the existing systems, which often includes destructive testing and involvement of the contractor in the design development phase. This paper will also provide an introduction to the standard testing procedures and offer additional guidelines for implementation of contractor services in the design development phase, and will ensure successful performance through construction. Procedures that will be discussed are:

- ASTM E2128, *Standard Guide for Evaluating Water Leakage of Building Walls*
- ASTM E2359, *Standard Test Method for Field Pull Testing of an In-Place Exterior Insulation and Finish System-Clad Wall Assembly*
- ASTM D2829, *Standard Practice for Sampling and Analysis of Existing Built-Up Roof Systems*
- ASTM E907, *Standard Test Method for Field Testing Uplift Resistance of Adhered Membrane Roofing Systems*
- ANSI/SPRI FX-1, *Standard Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners*
- ASTM C1153, *Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging*
- ANSI/SPRI/RCI NT-1, *Detection and Location of Latent Moisture of Building Roofing Systems by Nuclear Radio Isotropic Thermalization*
- ASTM D7954/D7954M-14, *Standard Practice for Moisture Surveying of Roofing and Waterproofing Systems Using Non-Destructive Electrical Impedance Scanners*

Finally, to highlight practical application of these guidelines, the paper will review procedures successfully implemented by the authors on prior collaborative restoration projects. To summarize, the objectives for this paper are as follows:

- Discuss roles and responsibilities of consultant and contractor in BE projects.
- Introduce testing procedures used to analyze BE system applications.
- Provide practical guidelines for development of collaborative construction documents.
- Offer ways to set each other up for success and to value our services.

INTRODUCTION

Collaboration between a consultant and a contractor that results in a positive work relationship is beneficial for a client and the successful completion of the building envelope project. During the project life cycle, there are several phases and specific tasks for which each party is responsible. With proper planning and understanding between each party, this collaboration between the consultant and contractor results in a more continuous work cycle with less reworking and disruption to the owner and/or other trades. This includes working together through the investigative, design, bidding, permitting, construction, and close-out phases.

Roofing, waterproofing, and exterior wall construction projects—whether new construction or restorations—require interaction with many different parties. These can include architects, engineers, consultants, contractors, owners, manufacturers, suppliers, lenders, and many others. While there are many different ways in which construction projects can be structured, this paper will focus on the relationship of the roofing, waterproofing, and exterior wall consultant and the contractor during the course of a typical construction project, and how these parties can support each other and ensure the success of the project.

ROLES AND RESPONSIBILITIES OF CONSULTANT AND CONTRACTOR

The RCI *Manual of Practice* states, "The success of the project is often dependent on how well the participants understand their roles and responsibilities and those of the other parties and how well they meet the expectations of others." This statement could not be truer. When the team members of construction projects have respect for each other and know what each party is supposed to do, those projects are generally successful and provide a better experience for all. Whether that means an owner wants the project to be completed on time, the contractor wants to be under budget, or the consultant wants the correct repair, each member of the team often can have different and sometimes competing expectations.

Referencing some of the standard contract terms, the owner is defined as a person or entity that owns the property at which the work is being performed. The architect, engineer, or consultant is the person who administers the contract for construction. They serve as a representative for the owner, but not as an agent for the owner. The architect, engineer, or consultant typically contracts with the owner separately to provide architectural, engineering, or consulting services and usually is the one who has developed the contract documents. The contractor is the person or entity identified to perform the work in accordance with the contract documents. The contractor supervises and directs the work. The contractor is responsible and has control over construction means, methods,

techniques, sequences, and procedures and coordinates all portions of the work. The consultant can also serve to support any one of these prime parties; or, in some cases, he or she can be one of the prime parties—for example, when the consultant is serving as the design professional. The consultant can also be retained by the contractor, insurance carrier, lender, developer, or other interest. In these cases, there is often another architect or engineer who is retained by the owner and is the design professional on the project.

The RCI *Manual of Practice* identifies several common consulting services a competent roofing, waterproofing, and exterior wall consultant may perform during the course of a building envelope project. These services can include:

- Identifying problems and field investigations
- Performing moisture intrusion testing, nondestructive tests, and laboratory tests
- Design services and development of construction documents
- Bidding, addenda, and contractor negotiations
- Construction contract administration
- Third-party quality assurance and inspection services
- Expert services
- Insurance claims
- Assessment management

Contractors are one of the parties to the owner/contractor agreement, which, depending on the contract type and owner (i.e., private or institutional), establishes the requirements of the project. Often there may be special insurance or bonding requirements, time restrictions, or cost limitations.

Contractors are also governed by the building code of the jurisdiction where the work is being performed, which exists at varying degrees of specificity. There may be national or state codes, special territory or municipality codes, or special requirements of the owner. These codes generally focus on life, safety, welfare, and increasing energy consumption requirements. However, most building codes are not generally concerned with durability and life cycle cost outside of the procurement method. The contractor is also responsible for quality control as it relates to manufacturers' published standards, general trade or industry standards, specific owner stipulations, and the consultant's specific requirements as typically outlined in the construction documents.

It is also the contractor's responsibility to maintain a safe working environment as dictated by the governing body of the jurisdiction in which the work is performed (i.e., OSHA for the U.S). This often includes certifications for handling of hazardous material, such as lead and asbestos. Additionally, it is the contractor who generally provides umbrella insurance that provides coverage and protection throughout the duration of the project.

The project-specific certificate of insurance also includes any damage to personnel and real property that may occur during the construction process. The liability rests with the contractor to protect the building occupants during construction, as the building enclosure is exposed to a semi-permanent state until the final system is installed during both new and rehabilitative construction projects.

PROJECT LIFE CYCLE FOR BUILDING ENVELOPE PROJECTS

During the course of a construction or rehabilitation project, several phases generally exist that have specific tasks associated with them. Depending on the type of project and whether or not it is new construction, more or fewer of these phases may occur. The typical project cycle consists of schematic design, design development, construction documents, bidding/pricing, construction administration, and maintenance. For renovation or repair projects, one of the first steps in the process is performing an investigation or assessment of the existing conditions. This could also be referred to as the schematic design phase, to draw some parallels to new construction work. However, it should be noted that situations may arise in which work performed during a latter phase may warrant revisiting a former phase prior to moving forward.

Investigation or Schematic Design Phase

A visual inspection is often the quickest way to get a general overview of the existing systems' performance and inventory of the components that comprise the exterior envelope. These observations can then be used to develop a plan for more extensive testing, generally to find the root cause of building failures or problems, compatibility of rehabilitative systems to new construction, and/or potential repair methods. When water leakage is a problem with the building envelope, performing a series of water tests is typically required to identify those components that have failed and those that are still functioning. In order to determine the leakage paths through the envelope,

Figure 1 – View of a large inspection opening on a steep clay-tile roof of a high-rise condominium.

Figure 2 – View of water leakage testing in progress, isolating the window assembly.

Figure 3 – View of significant water infiltration and deteriorated interior finishes.

inspection openings are often required. Similarly for roof replacement-type projects, determining the extent of entrapped water within the roof assembly will often determine whether or not complete removal of an existing roof system is required. These types of tests and inspection openings allow the consultant and contractor to evaluate what repairs are needed and to better determine the scope of repair work.

Testing as a component of the schematic design process is a valuable tool for providing guidance in qualifying and quantifying the scope of design by providing insight into the condition of the existing building components and the extent of degradation or failure. There are two basic categories of testing: destructive and nondestructive.

Destructive tests assume that the existing system will be compromised or partially destroyed as a result of the test being performed (for example, core sampling, impact, or adhesion of the existing system). Destructive testing of the built environment is often required for proper system analysis and can be highly involved from a sequencing standpoint, which may lead to a building being left in a somewhat compromised state for several months at a time while design and procurement of necessary funding is achieved (*Figure 1*). This makes the execution of this work and coordination between active participants a critical step for success of these procedures.

A proper and thorough investigation by the consultant will include documentation of hidden as-built conditions and modes of failure, and will provide the basis for meaningful project repair design. During this phase, the contractor will be required to maintain a functioning building envelope, including any historical preservation implications, moisture intrusion, or life safety issues that may exist.

Consultants may perform some tests or have them done by a contractor, or a hybrid of the two. Liability concerns are raised when services are rendered without a formal contract, such as when the work is done as a favor. For existing buildings, we recommend developing a written scope of work and obtaining a signed proposal from the owner that clearly states what the investigation will entail and how the envelope will be repaired or maintained in the interim. When contractors are retained to assist with destructive testing, they can then also make the needed repairs to the building envelope to ensure no other damage occurs to the building, thus limiting the potential for leaks and other disruptions to the owner. Some of the commonly used test methods during an investigation or schematic design phase are summarized below.

TESTING PROCEDURES USED TO ANALYZE EXISTING BUILDING ENCLOSURES

ASTM 212, *Standard Guide for Evaluating Water Leakage of Building Walls*

When evaluating the performance of an existing building's wall assembly, this guide describes standardized methods for evaluating and determining the sources of water leakage into the exterior wall assemblies. The standard evaluates the performance of the wall assembly and the related components and adjacent construction. This guide describes a systematic procedure for evaluating the sources of water leakage. The recommended approach consists of reviewing project documents, evaluating the original design, determining the service history, conducting inspections and investigative testing, analyzing the results, and documenting the evaluation in a report. Several different types of investigative tests can be utilized to recreate the leakage and identify leakage paths through the exterior wall assembly (*Figures 2* and *3*).

Often, these tests can involve making inspection openings into the assembly to verify the leakage path or source. This particular guide is not intended to serve as a quality control procedure itself; however, many of the tests that are performed can and are used in a quality control program.

During these tests, it can be expected that water will infiltrate into the interior or within the exterior wall assembly. The owner needs to understand that disruption of the interior spaces will occur. This may include temporary relocation of tenants and repairs to the interior finishes.

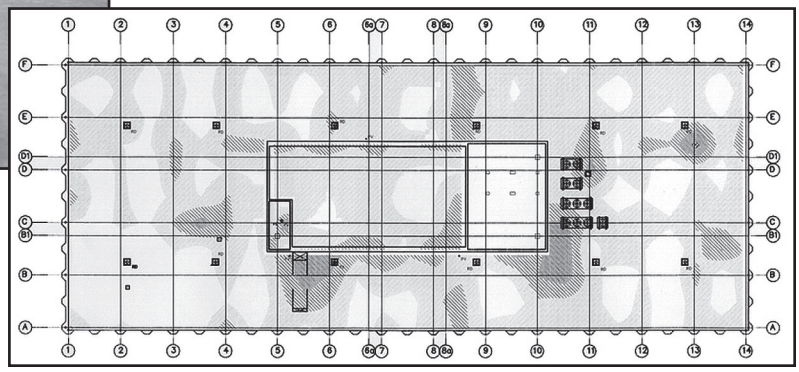
Figure 4 – View of wet region of roof insulation adjacent to the parapet wall.

ASTM C1153-10, *Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging*

When investigating existing roof assemblies for location of wet insulation, either for leak detection or suitability for recovery roof system application, the use of infrared imaging provides an effective means to analyze large areas of roofing in a relatively short period of time (*Figure 4*). Performed at night and either on the roof or from an aircraft, infrared scanning can be a useful tool for system evaluation.

This standard outlines the procedures for calibration of equipment, the effects of climatological conditions, and the variability that roof assemblies can have on the analysis. It also provides guidelines for destructive testing to verify the presence of moisture in the identified anomalies. Limitations of this procedure are the need for dry, calm weather and roof assemblies without overburden such as ballast or pavers.

Figure 5 – View of nuclear meter survey and moisture map.



ANSI/SPRI/RCI NT-1, *Detection and Location of Latent Moisture of Building Roofing Systems by Nuclear Radio Isotropic Thermalization*

Test for moisture by the implementation of nuclear radio isotropic thermalization or "nuclear scanning," as it is commonly called, is also a useful tool for investigating existing roof assemblies for location of wet insulation—either for leak detection or suitability for recovery roof system application (*Figure 5*). It is unique in that it has the ability to penetrate roofs with a thicker cross-section and those with overburden. Testing is also not limited to the weather and time-of-day constraints that affect infrared analysis.

This standard outlines the procedures for calibration of equipment and use of the nuclear gauge, as well as standard grid mapping recommendations for a thorough analysis. Because of the inherent health risks associated with nuclear equipment, the use of this equipment is highly regulated and requires specialized training, maintenance, and travel and storage logs. Because of these restrictions, nuclear has become the least-common test procedure implemented and requires the use of a specialized testing consultant.

ASTM D7954/D7954M-14, *Standard Practice for Moisture Surveying of Roofing and Waterproofing Systems Using Non-Destructive Electrical Impedance Scanners*

The use of electrical impedance (EI) scanners to determine the presence of moisture in new and existing roof assemblies is also an effective way to analyze localized areas quickly and with fewer weather restrictions than infrared analysis and

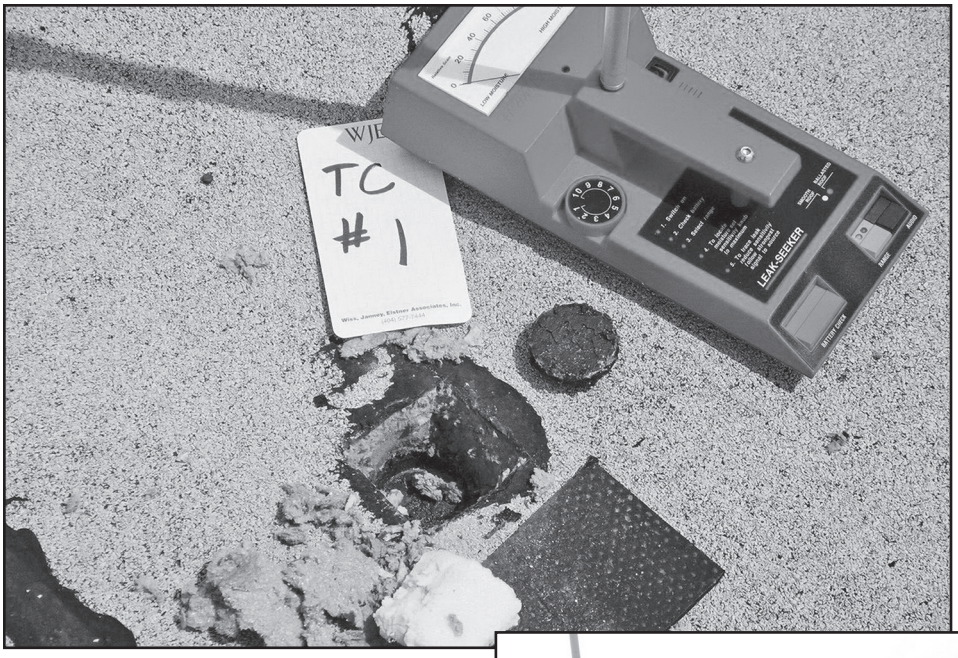


Figure 6 – View of electrical impedance test and inspection opening for calibration.

Figure 7 – View of roof uplift test in progress.

fewer regulations than nuclear scanning (*Figure 6*). This standard outlines the proper procedures for conducting the moisture survey, limitations related to the composition of the system being tested, and the need for destructive testing to confirm the identified anomalies. It is not appropriate for use over black EPDM and some coated roofs. Like nuclear scanning, the testing is limited only to the area under the gauge, so testing large areas can be time-consuming.

ASTM E907, *Standard Test Method for Field Testing Uplift Resistance of Adhered Membrane Roofing Systems; and* FM Global Property Loss Prevention Data Sheet 1-52, *Field Uplift Testing*

The use of "bubble tests" as described by these standards are for the purpose of testing in-situ roof components for resistance to uplift forces for quality assurance purposes with new systems, post-storm evaluation, and for suitability as a substrate for recovery systems (*Figure 7*). These standards give guidelines for frequency of the tests and protocol for performing the tests, as well as equipment calibration. Consideration is also given to the age of the system for new construction to ensure that all adhesives have reached optimal cure and represent the true resistance strength of the material. When utilizing these test procedures, it is also prudent to factor the effects of deck deflection on the test results.

Table 1 compares the various nondestructive moisture test methods and their use under different conditions.

The procedures for sampling existing asphalt roofs, as outlined in this standard, are useful for determining composition and unit quantities of the system components. Standard D3617 should be utilized for quality assurance of roofs under construction. In it, the methods for extraction and analyzing the samples are discussed. This standard can be used as a component of the condition assessment; however, it does

	ASTM C1153	ANSI/SPRI/RCI NT-1	ASTM D7954/D7954M
Weather Sensitivity	High	Low	Low
Scan Area	Large	Small	Small
Depth of Scan	Surface	Multiple layers	Surface

***Table 1 – ASTM D2829*, Standard Practice for Sampling and Analysis of Existing Built-Up Roof Systems.**

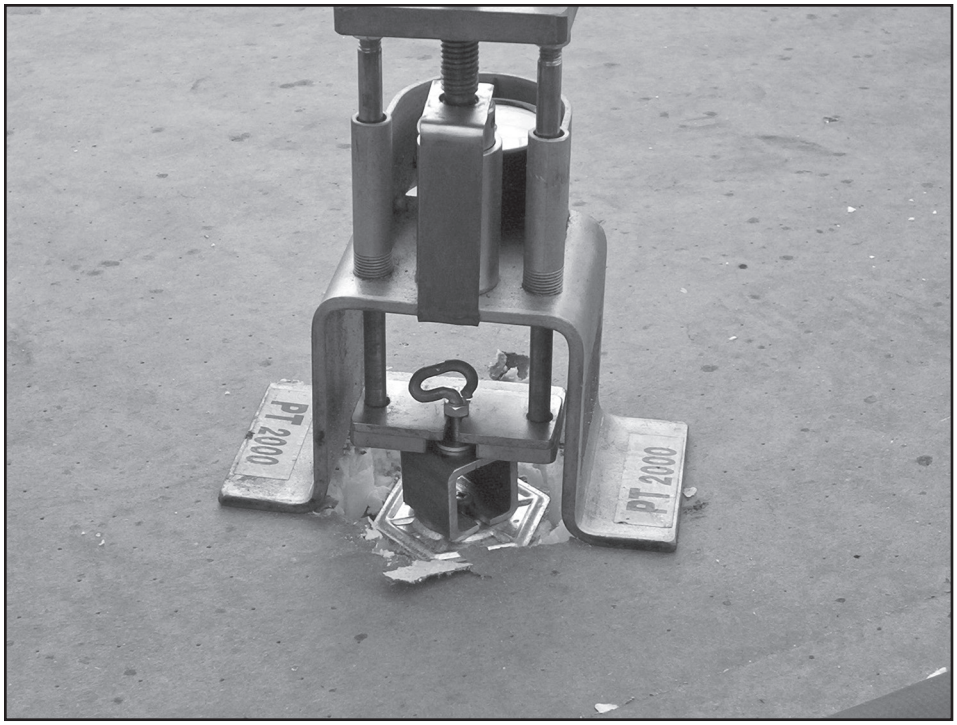


Figure 8 – View of roof fastener pull test to determine withdrawal resistance.

result in relatively large extraction sites left in the existing roof that will need to be made watertight.

ANSI/SPRI FX-1, *Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners*

The use of mechanical fasteners to secure roof system components to structural elements is an effective and economical way to install roof systems (*Figure 8*). This standard provides guidance to establish the site-specific resistance of a specific fastener for a specific embedment into the existing decking. It also outlines the protocol for frequency of the test and calibration of equipment being used. It is important that any critical areas are tested and that any anomalies—particularly those that are significantly lower than the average—are independently investigated.

Mock-Ups/Design Development Phase

Similar to the testing of existing components in the schematic design phase, mock-ups can be utilized during design development to determine viability of proposed products and can test performance and/or aesthetic compatibility (*Figure 9*). They can be done as a free-standing model, common with new construction, or as an attachment to the existing building, which is more typical of rehabilitative or re-use projects. Mock-ups can also vary in complexity from a multisystem (e.g., masonry, stucco/EIFS, and siding) exterior wall that incorporates storefront windows to simply an application of a topical coating to an existing exterior surface. Generally, mock-ups should be of sufficient scope to provide a basis of comparison or analysis so that the desired performance characteristics can be confirmed prior to applying the final system over the entire project. Some mock-ups can be constructed by the consultant, but most are typically constructed by the contractor with the guidance of the consultant.

Developing the mock-up should be approached as a learning process for both the consultant and the contractor. Mock-ups can validate if a particular design solution will work effectively, or if aspects of the repair cannot be effectively implemented. Failures of the mock-up generally occur, and no offense should be taken when failures happen. The mock-up phase is the opportunity to establish what the expectations for the repair are to be. The mock-ups should be large enough to establish what will be the standard for the project. Performing water leakage tests or air leakage tests is often required to evaluate the performance.

Most design architects will include mock-ups to review the aesthetics of the envelope components with the owner. These are the elements that most people will care about. If the aesthetics are not resolved prior to implementing the repair, it is to no one's benefit to hear, "Well, that just does not look good," once the project is finished.

Figure 9 – View of large-scale off-site mock-up used to evaluate aesthetic issues in addition to water leakage performance testing.

The old saying, "beauty is in the eye of the beholder" will definitely apply in these situations. However, besides the fact that the installation may not look good, most owners will care about performance of the envelope when they find out later that it does not perform.

Design/Construction Documents Phase

During the design phase, the contractor can provide valuable input regarding the possible means and methods for a particular repair, which ultimately may influence the type of repair that is designed (*Figure 10*). On larger construction projects, and with the advancement of building information models (BIM), contractors are often engaged early in the design development process to assist with equipment and product selection, installation sequencing, and cost estimating exercises. Depending on the potential existing site access limitations, the type of materials proposed or how the work is sequenced could be altered. For instance, if a crane cannot be positioned to easily stockpile materials, and everything will need to be carried by hand to the roof, the use of heavy roof pavers might be prohibitive. Similar approaches can be effectively implemented on building envelope projects. The design phase allows the design team to better tailor the design and specific details to the building. This process engages the installer, who can evaluate details, resolve conflicts, and include this information in the construction documents.

Seeking appropriate input from the contractor during the investigation and design phase of the envelope project to understand how the work may be implemented can have positive effects. The consultant's expectations for the repairs and what is being communicated to the owner may not be in alignment with how the work will actually be sequenced, which could negatively impact the owner's expectations. Also, the owner may impose certain limitations or have requirements that will influence the sequencing and cost of the work. Collectively working as a team will identify the best method to address all parties' concerns.

During the design phase, the consultant is responsible for developing the plans and specifications for the repair of the building envelope. Depending on the repair or system, this work may require that the design work be performed by a licensed design professional. Often there are code implications, load requirements, and slope and drainage considerations that a design professional must address in the documents.

Figure 10 – View of inspection opening in an existing stucco high-rise wall assembly to evaluate effectiveness of the proposed repair.

Bidding/Pricing Phase

Once the construction documents are completed, the process of bidding begins with the goal of achieving the best value for the owner. There are several forms of owner/contractor agreements that can impact the bidding process. The bidding process is often initiated by an invitation to bid, which is then followed by a pre-bid meeting, a question or addendum period, and ultimately the submission of the bid by the contractor to the owner's representative. This process can be structured and formal, as is the case with publicly bid projects, or informal ones, as in the case of private work. As such, the time period can vary from weeks to months, depending on the complexity of the work being bid. In the case of restoration projects, the pre-bid meeting is often the first time the contractor is seeing the building and the required work to be done. The ability of the contractors and consultants to communicate at this phase is critical to ensuring that the design intent is understood and that complete bids will be submitted. Documentation of these questions and answers should be recorded and distributed to the interested parties as addenda to the bidding documents. It is also common to see several alternates included in the bid documents to accommodate budget constraints and to give the owner flexibility when awarding the work.

The ultimate goal of the bidding process is to provide the best value for the owner. This process allows the owner to develop accurate budgets and evaluate market conditions. There are several different ways in which a project can be priced and procured, and there are many different types of contracts that can be used on a construction project. The American Institute of Architects (AIA) has contract types for projects from small to large, public and private, and multiple or single contractors.

- **Negotiated bid –** Qualification of the work and competency of the bidder to complete the work may involve an interview process. This method could be beneficial when continuing multiple sections of a similar construction.
- **Competitive bid –** During a competitive bid, it might be best to prequalify and again establish minimum criteria regarding the amount of experience, location of the contractor, and contractor's availability.
- **General contractor with competitive bids from subcontractors –** The roofing or waterproof-

ing contractor may act as general contractor in some instances when limited trades are involved. When this occurs, consideration for the qualifications of the subcontractors also needs to be given.

- **Construction manager –** An owner can retain a construction manager who can negotiate the contracts for the work. Typically, construction managers do not engage in any of the construction work.

The bidding and pricing phase of a project—when a general contractor or construction manager is brought on board by the owner, though the development of pricing, budgets, and actual design are not complete—can be quite challenging. Often, it is at this point that once a price is provided, expectations by the owner are set without regard for what is actually going to be required in the envelope scope. From this point forward, price will simply drive all decisions. The consultant has the responsibility to then educate the owner on what those price expectations will lead to. Often, they can involve inferior products or repair approaches that may not address all of the needs.

How can a contractor do this without handcuffing the design professional by simply offering the cheapest solution from a roofing or envelope standpoint, and at the same time, protecting the owner from price gouging that same cheap solution? Consultants and contractors need to engage and educate the owner at the beginning of the process as to what the standard of care will be. Performing a thorough investigation and constructing detailed mock-ups will often alleviate many of these headaches.

Bid submission and subsequent openings can also be public, with immediate notification of the apparent low bidder; or private, without notification until all bids have been received by the owner and reviewed with the consultant. In some cases, the owner may opt to interview two or more contractors when the submitted bids are within close range of each other. Conversely, a contractor may also be asked to qualify a bid that is abnormally low relative to the other bids to avoid undue financial hardship as a result of trying to complete the work with insufficient funds. Bid bonds may be required by the bid documents and can also help in the case of an incorrect bid being submitted.

Once the bid process and the awarding of the contract are complete, the project moves toward commencement of construction. One of the first steps in the construction phase is securement of a permit for the scope of work to be completed with the jurisdiction having authority over the project. Permits are generally tasked as a responsibility of the contractor, though permits can be obtained by the owner. Permits generally assign responsibility for the work performed and include minimum standards. These standards and the permit application process vary greatly, depending on the complexity of the project, sensitivity or importance factor of the facility use, and the location of the project. The process can be as simple as a courtesy call to the governing construction office or so complex that formal meetings are required to review the submitted applications. In some instances, permits may not be required in the case of regulated sites such as large manufacturing mills that have site-specific requirements in lieu of the permitting process. Obtaining competent guidance specific to each project is an important consideration for successful project delivery.

Construction and Construction Administration Phase

Starting construction on a project can often be a very stressful time for the various parties. How the various parties all came together on the project can and will influence each other's perspective. Owners are nervous about how the project will impact their tenants and operations, or if additional costs will be incurred. Contractors are mobilizing on site and obtaining materials and learning about the conditions of the building. During the course of the start-up, unexpected conditions can adversely affect the schedule that was proposed. Consultants may be uncertain about a contractor's qualifications and ability to successfully perform the work. These are just a few of the myriad issues that can develop during the course of the project.

Effective communication during the course of the project, no matter its size, is critical to ensuring successful coordination among the parties. Conference calls, weekly or biweekly meetings, regular site visits, and timely production of documents are just some of the ways we communicate on projects. The tone of conversation is also important. Depending on the audience involved and the depth or level of the conversation, a project meeting sometimes might just get to the highlights, or a 30,000-foot view. When this occurs, scheduling a separate meeting at which specific items are discussed in more detail may be required.

When both the consultant and the contractor can communicate effectively and know each other's roles and responsibilities, the success rate of the project is increased. In the end, the owner is the one who ultimately benefits. During the construction phase of a project, some items that can place a strain on contractor/consultant relationships include changes in work scope, poorly defined documents and submittals, scheduling, and defective work.

It is usually inevitable that field conditions will require a change in the scope. A thorough investigation and mock-up will limit these situations from occurring or resulting in costly change orders that are not anticipated by the owner. The investigation and mock-up phases should have identified those items that may not be completely quantifiable during the design phase, such as the extent of tuck-pointing or the amount of concrete spall repairs. However, having established a good representative quantity and unit cost will generally eleviate large swings in unanticipated costs.

When the project is underway, it can be frustrating for the owner and consultant when it becomes clear that the contractor did not adequately review the contract documents that were provided to fully understand what the scope of the work entails. Designers sometimes develop specifications or documents that are too general or include unrelated information not relevant to the project. This creates an environment that encourages contractors not to bother becoming familiar with the requirements. However, if the documents are clear, concise, correct, and complete, the scope of work will be much better understood by all parties.

Consultants and contractors can streamline the submittal process. It is becoming increasingly more common to have product submittals provided online or in digital form. This simplifies the numerous redundant copies, and all parties can have access to the submittals. Digital or PDF submittals also ease the process of resubmittals and tracking the progress.

"Time is of the essence," "construction schedules are compressed," "owners want the project completed yesterday," and "con-

sultants are never on time" are all common phrases that we routinely hear on projects. While many of these may in fact be true, it is critical that all parties in the envelope process understand what is required of them and when they need to complete their part of the project. Having weekly or biweekly, regularly scheduled project meetings will prevent some of these time and scheduling issues. When circumstances develop on a project that require immediate attention, contractors need to understand that many consultants have multiple projects that they are working on, and scheduling conflicts are bound to rise. In turn, consultants have to appreciate the contractor's schedule, and often, further work may not be able to occur until an issue is resolved. During the project meeting, identifying those items that are on the critical path and those that are not will allow the team to best coordinate each other's schedules to most efficiently solve the problem without delay to the project. Some owners may elect to reduce or eliminate these meetings in an effort to reduce costs—in particular, the consultant's costs. Consultants and contractors need to demonstrate the value of these meetings for the relatively minor costs they incur overall.

Establishing work standards during the mock-up phase will reduce the potential that defective work will occur as the project progresses. When defective work does occur, tensions are elevated. Contractors do not like to remove items and redo things, as this affects schedule and budget. Determining the cause of the defective work is critical in understanding how to best resolve the issue. If the defective work is due to a lack of supervision of new personnel not familiar with the mock-up, in addition to correcting the work, improving the level of supervision is also necessary. Individuals who were part of the mock-up phase should be encouraged to continue performing the same tasks, if possible, since they have shown they can meet the expectations of their part of the project.

Maintenance Phase

The final phase of the construction life cycle is the operations and maintenance (O&M) and is generally the longest but least-intensive phase. It also exists outside the structure and timeframe of the owner/contractor and owner/consultant agreements, once the contractor's workmanship warranty and the statutes of limitation for the design expire. O&M practices are the responsibility of the owner, but may still involve contractor services, and generally include inspection, cleaning, and repair of damage that occurs as a result of building use. At the end of an envelope project, consultants can assist owners by providing them with a maintenance manual that addresses the materials that were used during the project. The manual will provide the owner with an understanding of the life cycle expectations of the various materials, providing guidance about when the materials should be inspected and replaced. This allows the owner to make better capital decisions.

WAYS TO SET EACH OTHER UP FOR SUCCESS: THE VALUE OF OUR SERVICES AND PRACTICAL GUIDELINES FOR SUCCESSFUL COLLABORATION ON BUILDING ENVELOPE PROJECTS

Investigation/Schematic Design Phase

- On any project, establish the roles, responsibilities, and expectations that each party may have. Encourage the owner to establish contracts and get other parties involved when necessary.
- Know when to recommend that the owner engage a contractor or a consultant. If team members admit limitations, the owner can feel comfortable that each party is focused on core competencies.
- Stay on top of industry issues and trends. This applies to both the consultant and the contractor. Some recent industry issues include energy consumption and changes in polyisocyanurate insulation R-values, lightweight structural concrete and moisture-related issues, water-based adhesives versus solvent-based adhesives, and changes in the fire codes and subsequent material selections.

Testing Procedures Used to Analyze Existing Building Enclosures

- Utilize the expertise of the contractor and consultant during the investigation to assist with the nondestructive and destructive testing aspects of the investigation.
- Destructive testing is often required to evaluate concealed conditions, to remove and reinstall materials and interior finishes, or to provide safe access to the location being tested. This may also just be general demolition to expose the critical interfaces. Understanding the potential for disruption to occupants and operations is critical to making the project a success and requires input from all parties.
- Establish a contract with the owner that details the specifics of the tests and includes procedures for handling exposure to the building operations.

Mock-Up/Design Development Phase

- Develop and implement formal quality control/quality assurance procedures utilizing full-scale site mock-ups to establish the acceptable performance criteria. This limits and reduces the potential for the rejection of work.
- Anticipate that failures and issues will arise during the mock-up. One of the main purposes of the mock-up is to resolve issues and correct deficiencies before they are implemented on the building.

Design/Construction Document Phase

- When reviewing specifications as a contractor (hopefully before the bidding process), it can be difficult to ascertain the design intent if there is ambiguity or conflict within the specifications and drawings. Sometimes a "more is better mentality" is used, which leads to extraneous information being included, such as ASTM standards for copper products when aluminum is the preferred metal for the project. This can lead to bids that are incorrect because the right material was not accounted for. The CSI mantra of the 4 C's (clear, concise, correct, and complete) is sound guidance for avoiding this type of pitfall and can be used as a litmus test when preparing specifications for incorporation into the construction documents.
- Collaborating with the consultant and contractor can allow for a tighter development of the envelope scope and greater checks and balances when establishing prices and

bids. The cost of repairing an item versus the cost associated withaccessing the area can be evaluated, which may influence the type of repair. There are three components that influence the overall price of a construction project: quality, time, and cost. The owner can pick two of these items, but not three. It is not realistic to expect high quality and short construction time at a low cost. Alternatively, if time is truly of the essence, and there is a limited budget, the highest quality may not be achievable.

- While many owners may want to negotiate a guaranteed maximum price (GMP) type of contract, the contractor should avoid making design assumptions and pricing inferior methods or materials when the consultant has not yet fully analyzed and completed the construction repair documents. The integrated project delivery (IPD) approach can avoid some of the problems when the consultant is recommending a certain repair approach or system to be installed, and initial pricing has established a lesser standard. The IPD assumes collaboration between owner, contractors, consultants, and material suppliers is occurring throughout the design process to begin establishing the project requirements and expectations.

Bidding/Pricing Phase

- Assuming the scope and bid documents have been properly developed, the next step is securing qualified bids for the work. The best pricing comes from qualified contractors with advance notice and ensures that the most competitive pricing is submitted. Maintaining communication with the bidding community (contractors and subcontractors) ensures that multiple bidders participate and that there is sufficient interest in the project to receive bids and complete the project.
- Establishing annual programs is beneficial when dealing with multiple facilities and projects over a given year. Having a general meeting prior to initiating the bidding process allows the consultant to establish general conditions, such as owner-specific safety and operations policies. This information can be used as a guide for specifications that are universal so that project-specific details and logistics are the focus of the bid meetings. Additionally, projects and budgets for the upcoming year can be discussed so that interested contractors can better anticipate workload and be prepared to handle the upcoming projects.
- Is there value in value-engineering? If done properly, there are opportunities to look at alternative solutions that can meet the design intent while providing construction cost savings or "value." The caveat is making sure the owner is aware of the redistributed costs that come from the proposed changes. Generally, cost "savings" are provided in the form of reduced durability or redundancy in the installed system (i.e., reduced mil thickness or elimination of plies in multi-ply systems), and must be accounted for in the value equation to include the potential for increased maintenance and/or frequency of replacement. It can be beneficial to defer these costs, but this should be addressed with the owner prior to the bidding process, not after the remarkably low number shows up on bid day.
- Prequalification of contractors and subcontractors also contributes greatly to the quality of the bids received. By establishing these standards prior to the bidding process, the consultant can ensure that contractors have a true working knowledge of the specified systems.
- Conduct post-bid interviews with abnormally low bidders to determine if the qualifications or scope are well understood. Mistakes can occur in the bidding process, and placing any financial burden on a contractor is counterproductive to achieving a successful project.

Construction Phase

- Establish open and effective communication between all parties. In any emails, meetings, and conferences, 90% of the communication is not what is said, but how it is said.
- Ensure that both the contractor and the consultant provide competent people who understand the scope of the work and can effectively communicate. It is necessary to have QA/QC personnel who are familiar with the project and are able to speak in the local language.
- Permitting is often a lengthy process, depending on the regulating entity; and it is prudent to have the project preapproved or construction review coordinated with the design review as soon as possible in advance, as the contractor may need multiple permits from different entities. Sometimes architectural review is necessary in historic circumstances, or there may be multiple trades that represent plumbing, electrical, and HVAC. Having a local contractor with an established relationship with local trades and incorporating this information into the bid documents to the greatest extent possible is prudent.
- For existing buildings, obtain a preconstruction damage report developed by the contractor whereby items can be brought to the consultant's and owner's attention prior to construction. This avoids potential finger-pointing when items are later discovered as being damaged before the work starts. It also allows the owner an opportunity to address or include these additional items in the scope of work, if needed.
- Create an effective online project documentation and tracking solution to reduce paperwork and provide greater access to the various documents by all team members. Having a centralized portal also provides a singular set of working documents so that changes can be effectively tracked and incorporated into the project documents.
- Most sophisticated contractors will develop their own internal punch list prior to the consultant or owner developing theirs. This certainly eases the process of completing the punch list items, and many of the obvious items that otherwise would have been included on the list will already have been addressed.
- Finishing the project—which also

includes obtaining the various warranty documents and certificates—is also important. Including these items on the punch list is one way to ensure they are completed in a timely manner.

Maintenance Phase

- Have a formalized plan in place that educates the owner and includes established inspection and service intervals.
- Encourage owners to maintain records of access to the roof so that damage by other trades can be traced to the responsible party and establish protocol for reporting damage so it can be proactively addressed.
- Establish a meeting to review the roof between the first and second years after completion with the owner, consultant, and contractor to review performance prior to the expiration of the contractor's workmanship warranty. This is also a good opportunity to get general feedback of how the project went and opportunities for improvement going forward.

CLOSING THOUGHTS

- Consultants and contractors working together can protect the owner by reducing risk on a construction project.
- Building envelope consulting and construction is a service, not just a product. Understanding how the project team delivers the desired construction is equally important to the quality of the application.
- Value is not price. "Price is what you pay; value is what you get." – Warren Buffet.

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