DESIGN ISSUES: *The Devil in the Details*

By Don Kilpatrick

Figure 1– New construction featuring an array of solar tubes. It is assumed that performance could have been optimized if the units were installed without the cover of the overhead-projected soffit.

As practicing consultants with a chosen vocation placing an emphasis on the building envelope, a fundamental characteristic of our profession is to provide clients with professional services of a value consistent with or exceeding their expectations. It is intended that our deliverables will be worthy of our fees and perceived as a reasonable investment by the client. Challenges, or as discussed in this narrative, "design issues," are what keeps the life blood and revenues flowing, affording the consultant du jour the opportunity to put his or her own brand of engineering or creative solutions in play. Building owners engaging consultants can do so with the expectation that the selected service provider will pursue agreed-upon work scopes with a reasonable standard of care or due diligence. The added value of the owner/consultant relationship is found in management of risks, identification of conditions, and resolution of design issues that may have an impact on the project. This can include code compliance, lead time on custom materials, site logistics, and the key parameters of budgeting and scheduling.

Simply put, by default, we place ourselves in the best position to know. In promoting ourselves as design professionals charging compensation for our acquired expertise, we find ourselves and our reputations in the crosshairs of a higher calling. One of the fundamental core skill sets of this service industry is the ability to correctly identify parts of the assembly that, by function of age, lack of maintenance, or poor design, are no longer performing as intended. Once we have identified the nature of the existing conditions and, where applicable, the cause of the apparent distress in the building envelope, we draw from past experience to develop and communicate a condition-specific appropriate repair and maintenance program.

The aforementioned attempted definition of tasks and vulnerabilities is not all-inclusive and is intended as a summary of key points that should be given consideration when promoting oneself or one's organization as a "provider of design services" when working on existing buildings. The other end of the spectrum is represented by the new construction side of the industry—the birthplace of "post punch list blues," where craftsmen unwittingly comply with a marginal design or introduce workmanship and materials of questionable integrity to a component assembly that will predictably

Figure 3 – Two months after seeing Figure 2*, note the same TWF with intermittent loss of release paper and exposure to the elements, leaving self-adhesive or "sticky" side compromised to the extent that failure will occur.*

Figure 2 – Sight to be "unseen"—the birthplace of future performance issues with a through-wall flashing (TWF) condition.

fail. Most with experience in the field have firsthand practical knowledge with these types of shortcomings—while fulfilling the role of a third-party inspector, engaged to review a site-specific feature, or by chance observing construction site details or workmanship of marginal integrity. (It is hard to unsee some things; see *Figure 1*.) Each set of circumstances can cost building owners tens of millions of dollars. Some would argue that the default exposure is much more painful to watch, as it is accompanied by a sense of helplessness (*Figures 2* and *3*).

THERE'S NO APP FOR THAT

It can be said with a reasonable degree of certainty that there are presently no apps that can effectively take the place of a trained field technician assigned the task of gathering information that will serve as the basis for the design of a new roof or the repair and maintenance of an exterior wall assembly. Based on the size and overall scope of the project, this can be limited to "self-performed" activities consuming a few hours in a given day (consultant providing all labor and materials) with costs ranging from $1,000 to $1,500; or over extended durations, requiring specialty trades and costly rigging of buildings and with expenses running in the tens of thousands of dollars. A request for and delivery of the original building drawings and a few lunch meetings is not enough for the development of design documents, let alone the development of a project charter that places an emphasis on confirmed conditions rather than assumptions.

DESIGN ISSUES

Design issues are represented in any number of project layers, driven by what can be a seemingly endless number of variables. These include but are not limited to owner/occupancy issues, budget limitations, building relevance in owners' portfolios (keep it or flip it), construction schedule/window versus volume of proposed work scope, phasing considerations, climatic conditions, temperature limitations of materials, and lead time for custom materials. The above-described "soft" issues are usually fleshed out through dialogue with the owner in the design development (DD) phase of the project.

The tangible key parameters of design remain largely conceptual until the realities of the as-built construction are fully understood. Those with an interest in representing the clients' best interest have established processes that place a healthy emphasis on a reasonable standard of care or due diligence specific to the design process. Those who don't are quick to learn that the absence of the same provides fertile environs for costly change orders, callbacks for leaks, delays in construction, and loss

Figure 4 – Full-scale mock-up of a TWF condition on a new construction project. The design intent includes full support for the self-adhering membrane through the wall cavity.

of credibility. The process shall additionally acknowledge any special needs related to acceptance testing of materials, including full-scale mock-ups demonstrating proof of concept and standard of acceptance for the workmanship (*Figure 4*). On existing buildings, the consultant should work closely with the owner's in-house or outsourced environmental team, establishing proper protocols for hazardous materials, should they be encountered.

THE PROCESS AND THE ROLE OF ORIGINAL DRAWINGS

The availability of a roll or two of original drawings (best if both the architectural and the structural elements are represented) can be of significant value in the process. Through the review of project record documents, the team can learn much about the nature of the construction. These "blueprints" are found to contain pertinent information relative to site-specific conditions and areas of interest for the project currently in the queue (*Figure 5*).

While the information gleaned from project record documents has value, it should not be the sole source and determining factor or basis for the repair design. There must be an appreciation for the as-built conditions beyond what was offered in the original drawings, where as few as two dimensions are represented. The overall condition indices of those portions of the structure and/or architectural elements that are to remain need to be fully understood.

In the example shown in *Figure 5*, after a few hours of investigation in the confines of a dirty attic space, the team emerged with a field sketch that brought clarity to the section found in the original building drawings (*Figure 6*). With an additional review of the structural drawings (more notably, the steel schedule notations), the field measurements were cross-checked against those shown on the drawings. The key parameters of the as-built condition were established to an extent that the team's efforts could move to full design with a comfort level that all variables had been acknowledged (*Figure 7*).

It is at this stage that new/retrofit materials are interfaced with the existing conditions, culminating in a finished assembly of components that rely on one another for optimum performance. The majority of the information was derived from the building interior. On existing facilities, each condition or specific area of interest on the building requires a review of logistics from the perspective of design. Can team members get safe access to the condition, and will selective removal of exterior finishes be required to confirm the as-built conditions? Any consideration of temporary work platforms and selective removals comes with added cost and potential disruption of occupancy, so it is critical that this be discussed with the client early in the process.

Projects with an emphasis on the replacement of the roof covers on existing buildings are a little less challenging than the above-described scenario, as the body of work (the roof) is something that one can generally walk on, with few challenges or limitations in access. The same standard practice of due diligence remains, with the obligatory review of original building drawings required, followed by field work (*Figure 8*).

Field work as part of due diligence for the replacement of a low-sloped roof typically requires boots on the ground for a period of one or two days or as long as several weeks, with selective removals (targeted inspection openings and subse-

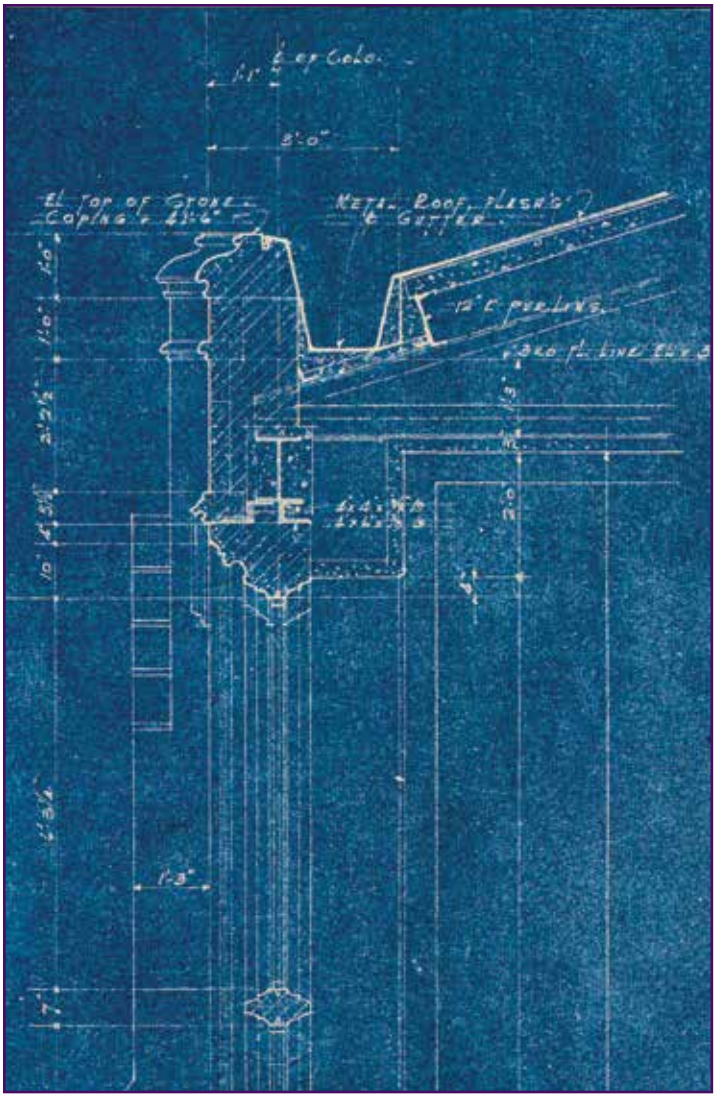

Figure 5 – A sample section drawing from original blueprints at low profile parapet/integral gutter/window head, additionally represented by Figures 6 *and* 7.

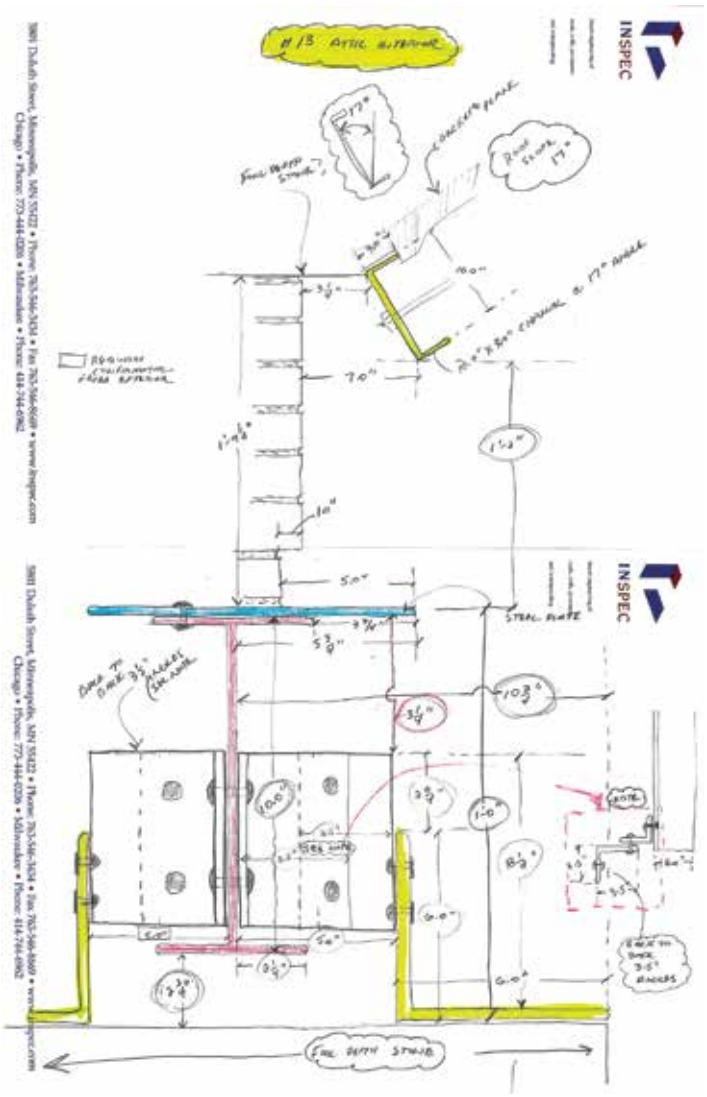

Figure 6 – Field sketch derived from a few hours of crawling around in the attic, additionally referenced in Figures 5 *and* 7.

Figure 7 – Repairs underway at conditions represented by Figures 5 *and* 6.

quent patching) either self-performed or executed with the assistance of a roofing contractor. As previously summarized, the objective with due diligence largely remains the same. Develop an understanding beyond reproach of the as-built conditions—more notably, the type, orientation, condition of and tolerances (height and width), and in some instances, means of attachment achieved by all portions of the existing construction (including those parts that may be destined for the landfill and those that will remain to carry the new assembly components).

From a very practical perspective, the process should focus on those portions of the existing roof cover that present the greatest amount of linear footage (i.e., roof edges, expansion/control joints, above-roof-line wall conditions). False starts or misrepresentation of intent in details with the

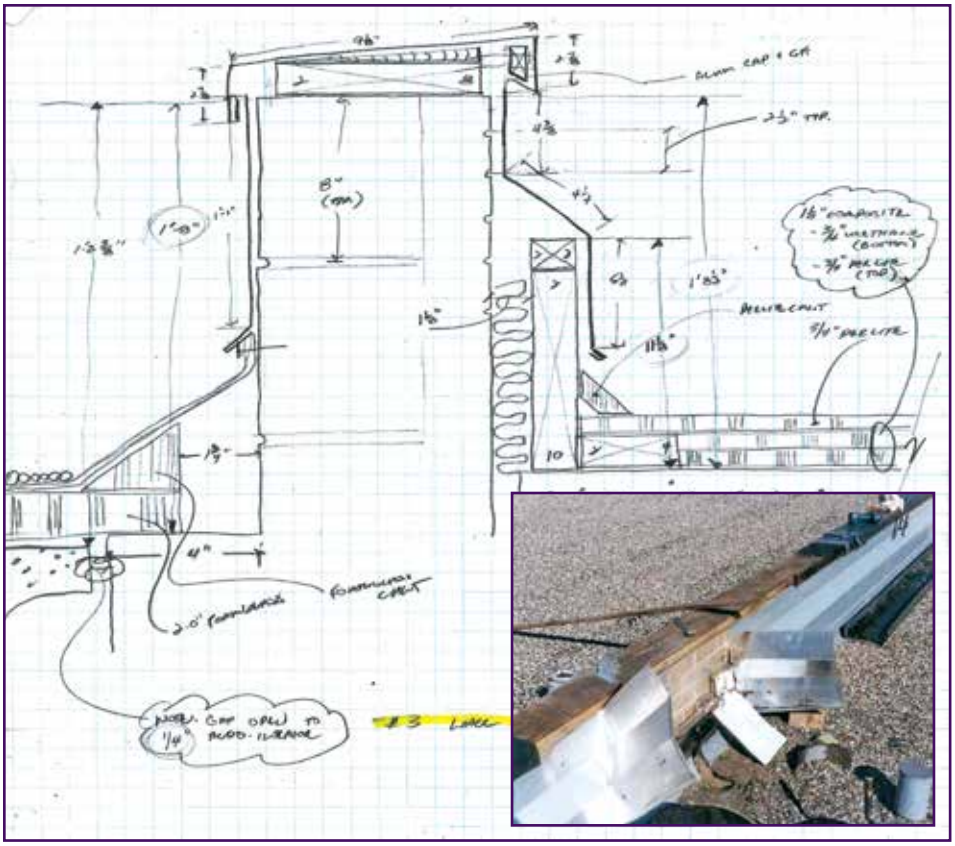

Figure 8 – Field sketch and targeted inspection opening at a roof expansion joint location.

greatest exposure can result in costly change orders. In this awareness, issues of occupancy can be proactively dealt with through the addition of some strategically placed notes on the details supported by additional references in the Summary of Work.

INFLUENCES OF MANUFACTURERS AND TRADE ORGANIZATIONS

As recently as 30 years ago, engineering consulting firms that derived their income solely from the discipline of roofing were relatively few in number. It was a niche market with minimal competition. Today's marketplace is flush with engineering consulting firms that offer services centered on the building envelope, many of which were weaned on the roofing component of the same and have grown their practice to include exterior walls, windows, and waterproofing, an evolution of sorts very similar to the revised charter of RCI.

As another option to the owner, some roof material manufacturers provide discounted roof consulting services to facilitate material sales. This practice would be categorized as the exception and not the rule. Most established manufacturers have detail templates for reference that impart to the end-user installation nuances specific to, or that are a requirement of, the design criteria to be eligible for their manufacturer-sponsored full-system warranties. Some offer extended standard-of-care agreements as a supplement to the "added value" service of design (*Figure 9*).

FULL DISCLOSURE

While much can be said about the consultant's role as a specialist in the field and in the best position to know, the client has an obligation to provide the consultant with quality information, as consultants "can only be as good as the information provided." While the aforementioned statement is generally accepted as true, it should not be considered a safety net or excuse for misrepresentations of a reasonable standard of care. Building owners and their representatives need to understand the importance of reasonably accurate descriptions of the circumstances that in whole or part are justification for the involvement of a design professional.

Likewise, as a means to provide reasonable assurance that the service package promoted by the consultant is consistent with the demands of the project, a clear summary or scope of work should be mutually agreed upon early in the process. Explain in very clear terms why and what you intend to provide, as well as what you will not be providing and why. Be clear in describing the form and function of system components/features that would otherwise

Figure 9 – The roof in this figure was designed by a manufacturer, with the owner under the impression that the service constituted "added value." No efforts were made to improve drainage. Minimally, a tapered insulation section or sump at the drain heads would have been added value.

be described as "accessories" or nonessential items of added value. Another example of this may be the obligatory structural evaluation for the introduction of aggregate ballast to an existing roof with an existing roof cover comprised of a smooth-surfaced built-up roof (BUR). To the consultant, the justification for the structural review is almost automatic, while the client or purchasing agent may not fully understand or wonder why this added layer of cost and effort is required. This information is typically defined in the request for proposal (RFP) process or a series of discussions, if one is fortunate enough to be working with clients that can sole-source engineering services with prequalified service providers.

Additionally, the client should be prepared to share any and all copies of reports by others and the original building drawings. On some projects, it may be prudent to develop a leak-tracking form for the owner to distribute to all tenants, recording the weather events associated with an occurrence (leak) and where on the building interior the free moisture was first observed. We have found that on occasion, a standard form works best, in some instances supplemented by an education module where trade terminology (i.e., window head, jamb, sill, condensation, leak) is defined; or if the occupancies are repetitive, a diagrammatic element may be included to afford the end-user the option of locating areas of interest.

REMARKS

The competitive nature of our business, intentionally or otherwise, misrepresents best value and best practice—desirable characteristics of the trade that are increasingly dismissed in favor of purchasing trends that are based solely on what is perceived as best or lowest price. Historically, the added expense associated with due diligence in the design process brings added value to the project in specific areas represented by:

- Systems selection compatibility
- Clarity/level of detail in the bid documents
- More-competitive, lower bids
- Superior long-term performance of finished installation

A carefully charted course and process that places an emphasis on an established standard of care or "due diligence" at the front end of almost any project will be of mutual benefit to the owner, consultant, and successful lowest responsible bidder. Beyond that, I offer the following bit of engineering poetry as found on the Internet:

CONSULTANTS' CREED

Of all the businesses, by far,
Consultancy's the most bizarre,
For to the penetrating eye,
There's no apparent reason why,
With no more assets than a pen,
This group of reasonable men,
Can sell to clients more than twice,
The same ridiculous advice,
Or find, in such a rich profusion
Problems to fit their own solution.

— Anonymous

Don Kilpatrick

Don Kilpatrick, an employee of Inspec, Inc., has been active in the industry for over 30 years. In the capacity of a project manager, he has been responsible for the initial sale of services, client relations, scope awareness, acquisition of field data, design, and coordination of all team members for both self-performed and subcontracted services. He is a longtime member of RCI's Interface *Editorial Board and a regular contributor to the journal.*

Jail Time Ordered Over Crane Fatalities

An Ontario court sentenced a former construction firm supervisor to 3½ years in prison for a 2009 scaffolding accident in Toronto that killed four construction workers and injured a fifth. Vadim Kazenelson, a supervisor for Metron Construction, pled guilty to four counts of criminal negligence and also paid a fine of $525,600. Company owner Joel Swartz was fined $112,500 after pleading guilty to four violations.