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# Leaky Roof Plazas Pose Inspection Problems

BY DAVID CAMPBELL

**Waterproofing expert shares his six-step procedure to find the point of infiltration and figure out what to do about it.**

Plaza construction has been part of the building landscape for quite a few years. Real estate can be used more efficiently when you allow pedestrians and vehicles to utilize the "roof" areas of a below-ground habitable space.

This convenience, however, creates an interesting challenge for the design professional, namely, how to keep this habitable space dry over a long

Infiltration is obviously not an issue with this type of plaza.

- Roof plaza. The roof or terrace of a building that is one or more stories above grade and has a wearing surface suitable for foot traffic.

- Roof plaza (grade related). The roof of a below-ground structure that is either accessible from or closely related to finish grade and has a wearing surface suitable for foot traffic and sometimes vehicular traffic.

For the purposes of this article, I will



period of time in the presence of hydrostatic pressure while also accommodating the abuse and dynamic loading associated with foot and vehicular traffic. The unfortunate reality is that most plazas experience varying degrees of water infiltration at some point during the life of the plaza.

The term "plaza" is used to describe several different types of outdoor horizontal areas constructed for human use. Most fall under one of the following categories:

- Ground plaza. A wearing surface built directly on-grade with no constructed spaces beneath.



limit the scope to "roof plazas (grade related)", which I will hereafter refer to as simply "plaza."



## INTRODUCTION

When a conventional roof develops a leak, locating and repairing the failure can be a rather straightforward process, since most materials are exposed to view and accessible and since standing water can be easily swept or drained away. Plaza waterproofing materials, on the other hand, are usually covered and hidden by many other materials and the waterproofing failure is typically in a hydrostatic environment. This makes locating, evaluating and repairing the leak more difficult, thereby requiring the additional step of conducting a leak investigation.

Since the cost and facility disruption associated with the repair of such plaza leaks can be considerable, the leak investigation report must identify the failure(s), assess the situation and provide the owner with the information necessary to select the most cost-effective course of action.

A thorough leak investigation report can be formatted in many ways, but should contain at least the following basic components: context information, documentation of the infiltration, documentation of existing conditions, evaluation and conclusions, recommendations, and cost estimating. The scope of a professional leak investigation should respond to the owner's needs and site conditions, while at the same time showing respect for his pocketbook. Consequently, there is no "one size fits all" leak investigation formula; however, there are six basic, procedural steps which, if followed, can help assure that all of the owner's needs are met.

The balance of this article will be an elaboration of those procedural steps:

- Initial site visit
- Office preparation
- Fieldwork
- Evaluations and conclusions
- Developing recommendations
- Estimating project costs

## INITIAL SITE VISIT

The initial site visit usually takes place prior to submitting a proposal to the owner. The purpose is to collect enough basic information so that reasonable assumptions can be made about the extent of service required and whether consultants will be needed, both of which will affect your proposal and fee. The following is a typical list of information obtained as part of the initial site visit:

### Obtain Existing Construction Documents

A copy of all pertinent construction documents of the existing structure should be obtained. It is important to make sure that you have the most current design documents and the documents of any adjacent projects that may have modified the original plaza design. It is not unusual for the installed waterproofing system to bear no resemblance to the original bid documents as the result of either value engineering or last-minute changes due to cost overruns. This is why special attention should be given to any addenda, construction

change directives, change orders, or as-built drawings that may have been issued.

The structural drawings often are more reliable than the architectural ones for such things as expansion joint widths and structural deck construction thickness, slopes and tapers.

Mechanical and electrical drawings can be helpful regarding pipe and conduit penetrations through the plaza deck.

## Document the Water Infiltration

Document all historical information about all infiltration including location, severity, frequency of occurrence, time of occurrence, related weather conditions, age of the infiltration, and the effectiveness of any previous repairs. Solicit the help of site personnel, if necessary. This type of information can be very helpful. For example, if the infiltration occurs almost all the time and does not get worse after a hard rain, the source of water may be a broken utility.

## Demolition of Interior Finish Materials

If the point of water entry on the structure is hidden from view by finish materials, ask the owner if the investigation should include selected demolition and repair of the finishes or will this be taken care of by the owner's facilities staff. This obviously will impact your proposal and fee.

## Determine Structural Conditions

If there are obvious signs of structural degradation, the scope of the investigation should include a structural condition survey. Obviously, it would be a disservice to the owner to design a new waterproofing system for an existing structure that has lost its load capacity and needs to be replaced. Even if there are no obvious signs of degradation during the initial site visit, such degradation may still be revealed later during your fieldwork when the interior finish materials are removed and the destructive test openings (DTO's) have been made.

## Observe Access to the Plaza

Check the vehicular access to the plaza. Will equipment have to be carried long distances?





### Is the Waterproofing Warranty in Effect?

If the existing waterproofing membrane is still under warranty, the membrane can only be cut and patched during the fieldwork by a contractor who is a certified installer of that membrane. Otherwise, you run the risk of voiding the owner's current warranty.

### Water and Electricity Availability

Ask the owner whether water and electricity will be available on-site during the fieldwork. If electricity will not be available, then prepare the owner for the noise from gasoline-powered saws, gasoline-powered generators or both. This can be a major issue if this fieldwork will be occurring near hospital rooms or classrooms.

### Noise Restrictions

Ask the owner when the best times are to schedule the noisy DTO work so as to minimize disturbing the building users.

### Special Clearances Required

Have the owner issue the appropriate site security clearances or parking permits prior to the fieldwork, if any are required.

### OFFICE PREPARATION

Office preparation includes a review of the existing documents, submitting a proposal to the owner, and preparing for the fieldwork.

### Review of Existing Documents

A thorough review of the existing construction documents can give the investigator insight as to what needs further site verification and what does not. Close scrutiny of the documents can help assure that the fieldwork is more of a surgical strike than a shotgun approach. For example, there may be an expansion joint in the structural deck that does not extend up to or is visible on the plaza surface.

### Preparing the Proposal

The Leak Investigation Proposal should clearly describe the project context, the scope of services, a proposed schedule, and the compensation. It has been our experience that sometimes an owner will be in such a hurry to stop a leak he will forget that the purpose of the investigation service is not to design the repair but to investigate the problem. Therefore, under the scope of services it should be made clear that neither

design nor construction document services are included.

### Fieldwork Preparation

Since the fieldwork represents the largest single portion of the fee, it is important to anticipate and prepare for every contingency so that your time at the site is spent efficiently and so you do not have to make any return visits.

- Destructive test openings (DTOs). Original documents, or even as-builts, should not be your only source of information when documenting existing conditions. These documents can be very helpful; however, there is no substitute for DTOs and the high degree of accuracy that is obtained by observing first-hand the installed materials. When planning the locations and quantity of your DTOs, it is important to remember that you want to collect as much information as possible without being excessive and wasting the owner's money. For example, if you need to dig a DTO at a drain, make the expansion joint DTO oversized and locate it between the two so that one DTO exposes both the joint and the drain. As another example, let's assume you need to expose the base flashing of a parapet and also that of a wall. If the parapet and the wall eventually intersect, you can avoid two DTOs by locating one larger one at the juncture. The investigator's level of confidence in the accuracy of the existing documents will impact the location and quantity of the DTOs. Generally, however, DTOs should be located at existing plaza drains, high spots, low spot expansion joints, parapets, walls, penetrations, areas of newer or older construction, areas of different wearing surfaces and, of course, above each different type of leak. Locating your DTOs only above the leaks will rarely give you adequate information. If there is any way that the design might allow water to migrate between the waterproofing membrane and the interior surface of the structure, then the membrane failure could be some distance away from the interior infiltration, thereby requiring additional DTOs at other key locations of the plaza. This type of water migration can also occur in expansion joints. If there is an absorptive compressible material within the joint, water can penetrate

the membrane failure at the top of the joint and migrate some distance within this absorptive material before it finds a sealant failure at the bottom of the joint.

- Scheduling. Depending on the project, there can be as many as seven other people whose participation during the fieldwork must be coordinated. Obviously, the owner and the owner's facilities people have to be made aware of the date and time of the fieldwork because parking, pedestrian traffic, deliveries, etc. might be affected. Also, if the DTOs will be dug in the spring or fall, make arrangements to turn off any electric snow melting systems the day of the fieldwork. If the existing membrane is still under warranty, you will need to schedule the services of a certified contractor to cut and patch the membrane, so as not to void the warranty. Since DTOs usually involve concrete or masonry cutting and/or extensive earth excavation, it usually makes sense to retain a local contractor for assistance. If the contractor is kept informed as to what minimum equipment he will need and what minimum skill level his laborers should have, then he can keep his costs down, which will reduce your reimbursables to the owner. If you suspect the presence of asbestos, either because of the specified materials or because of the age of the building, and your state requires special certification for the sampling of asbestos, then such an individual will have to be hired and scheduled accordingly. Interior air quality has become a major issue. If the owner wants you to include air testing results in the report, you should schedule an air quality testing service. The services of a surveyor to shoot some spot elevations may be required if you do not have the capability in-house. For instance, by reconciling the depths of the DTOs with their corresponding surface elevations, one can determine whether there is a slope or taper to the structural deck. Last, but not least, a utility marking service should be scheduled to visit the site and mark all buried electrical, cable and gas lines one day before the DTOs are dug.

### FIELDWORK

The reliability of your conclusions and





time-consuming abatement caused the project to exceed the scheduled completion date and interfere with a long-since scheduled graduation exercise.

Fieldwork is basically the documentation of existing conditions associated with the interior infiltration, the exposed plaza area and the DTOs.

### Interior Infiltration

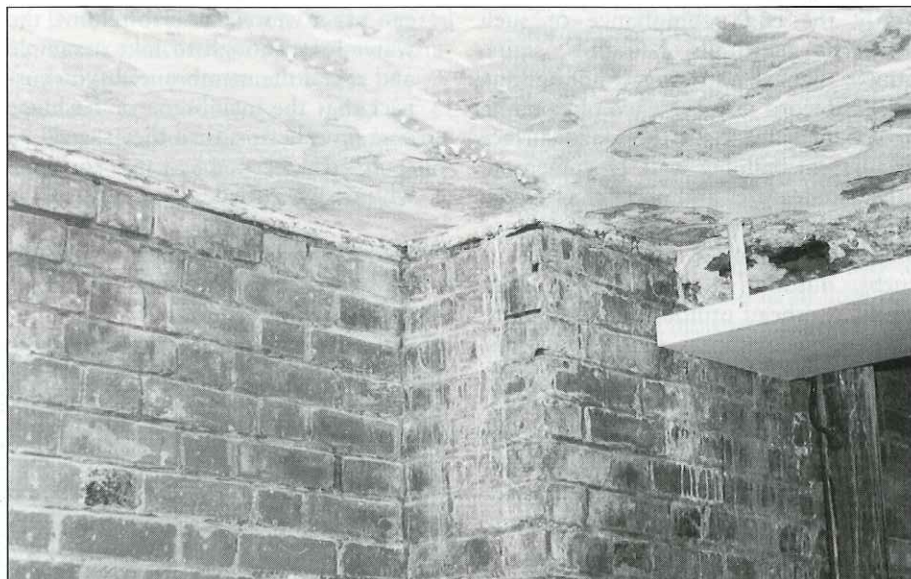
When documenting interior infiltration, it is essential that you identify where the water is entering the building through the structure, even if this means the selected demolition of various finish materials.

To illustrate the importance of this, a watermark on the underside of an acoustical ceiling tile could be caused by infiltration through a structural crack

effectiveness of your recommendations depend greatly on the thoroughness and accuracy of your fieldwork.

For example, an owner may decide to proceed with your recommendation to completely replace the plaza system, based on your cost estimate. However, if you failed to field verify the code compliance of the extensive guardrails and it turns out that the required upgrade would add 30% to the project cost, the owners might have decided otherwise and put up with the water buckets for another year.

To further illustrate, let's say that you sampled the existing built-up asphaltic membrane but neglected to have the felts tested for asbestos. Then, let's further assume that when the asbestos was finally detected during demolition, the



directly above the mark or, on the other hand, it could be caused by water leaking through the clamp ring of a plaza drain 10 feet away and following the underside of the sloped leader until it encounters a fitting, drops and stains the tile.

To further illustrate the importance of this, one might mistake numerous watermarks on the underside of a plaster and lathe ceiling as a badly failing waterproofing membrane when, in reality, the marks are the result of condensation forming on the underside of the structure due to a combination of high room humidity and a low R-value in the plaza assembly. You could call condensation the "fool's gold" of water infiltration.





### The Exposed Plaza Area

Verify the code compliance of such things as guardrails, handrails, stairs, ramps, signage, striping, and lighting levels. Record any evidence of ponding or water evidence on the plaza surface or adjacent building wall. Document all other site features and plaza characteristics including, but not limited to, planters, retaining walls, parapets, curbs, outdoor furniture, light standards, overhead utilities, building exits, plaza drains, scuppers, expansion joints, bollards, control joint patterns, aesthetic feature strips and plaza surface color and texture. Also of value would be the location of any special water sources such as roof downspouts, landscape irrigation, and decorative ponds and fountains.

### Destructive Test Openings

The following are six sequential steps one could follow when making DTOs:

- Make the DTO so as to reveal all materials down to the structural deck. The size of a DTO should be largest at the surface and get progressively smaller as different material layers are uncovered. This better enables the camera to pick up the sequence of materials and also facilitates the patching of the cut waterproofing membrane. The problem with using a core drill is that the cut waterproofing membrane is exactly the same size as the hole. This makes resealing the membrane difficult, if not impossible.
- Take samples of all materials, especially the waterproofing membrane.

If the membrane level is flooded, you can use a wet vacuum to remove the water long enough to take a sample and reseal the membrane. If you suspect that the membrane or flashings contain asbestos, then they should be sampled and patched by someone who is so certified.

- Next, photograph the DTO and all exposed materials.



- Next, sketch the complete composition of the plaza, noting all materials and their condition.
- Reseal the waterproofing membrane, keeping in mind that it might have to last a couple of years or more if the owner experiences "sticker shock" after seeing your estimated construction costs. If the membrane is still under warranty, have the certified contractor sample and reseal the membrane so that the warranty is not voided. The contractor will need to document the DTOs to send to the manufacturer for future reference.
- Finally, fill in and flush out the DTO to match the surrounding surfaces as closely as possible.

### EVALUATION AND CONCLUSIONS

There are a great many characterizations to a plaza assembly that, when properly evaluated, will reveal the plaza deficiencies and lead one to the proper conclusions. The following is a partial list of such characteristics.

### The Waterproofing Membrane

There are many waterproofing products that have been specified for plaza application over the years.

- Natural clay types. (Spray bentonite – two-part, one-part; bentonite mats – bentonite contained within geotextile; bentonite composite sheets – bentonite adhered to HDPE; and bentonite panels – bentonite contained within cardboard.)

- Loose laid sheet systems. (Thermoplastics – PVC, CPPE, HDPE, polyolefins and hypalon; and vulcanized rubbers – EPDM, butyl, and neoprene.)
- Fully adhered sheet systems. (Thermoplastics – PVC, CPE, HDPE, polyolefins and hypalon; vulcanized





rubbers - EPDM, butyl and neoprene; rubberized asphalt with polyethylene cover - "peel-n-sticks"; impregnated asphalt composites; and thermoplastic/asphalt composites.

- Preheated liquid applied systems (Hot rubberized asphalt - reinforced and non-reinforced; and hot mopped asphalts/coal tar - built-up.
- Cold liquid applied systems. (Cold rubberized asphalt and cold polyurethane based.)

When evaluating the membrane itself, the following characteristics should be evaluated:

- Has it retained its original elastic properties? This is especially important if there are numerous expansion joints or if the pre-cast deck has no concrete topping.
- Are the seams still well adhered? A tensiometer can be used to determine this if there is any doubt. Are the seams still watertight? Keep in mind that some membranes have various accessory products within their seams which do not necessarily last as long as the membrane itself.
- If it's an adhered membrane, is it still well-bonded to the substrate?
- Is there any evidence of shrinkage? Look for stress tears or bridging at plane changes.
- Are there any blisters or fish mouths?

#### The Termination

- Does the termination method used meet or exceed the membrane manufacturer's recommendations?
- Does the termination occur below the plaza surface? If so, it could be subjected to hydrostatic pressure.
- What condition is the termination in? For example, if a termination bar was used, have the anchors withdrawn or has the bar corroded?

#### Subsurface Water Management

Subsurface water management is any technique, device, product or combination thereof that provides a way for water above the waterproofing membrane to be discharged, thereby reducing hydrostatic pressure. Such things as "drain tile" composite discharge sheets (CDS), bi-level plaza drains, channeled insulation and aggregates would fall in this category.

- Are there provisions for such water management?
- Is the water management system clogged or closed off? Sometimes the vacuum-formed dimples of a CDS can be "driven" up into the insulation above it if the compressive strength of the insulation is inadequate for the weight of the overburden and the superimposed loads on the plaza. Generally, 40 to 60 psi insulation compressive strength is recommended.
- If there is a CDS or something similar, are the plaza drains bi-level so that the water can discharge? Are the lower

level openings of the drain clogged?

#### Water Migration Under the Membrane

When moisture is allowed to migrate below the waterproofing, then the geographical relationship between the membrane failure and the interior infiltration is severed, making it almost impossible to locate the failure.

- If the original design intent was to fully adhere the membrane, is it still well bonded? If the membrane is well bonded, the leak should be localized.
- Some membranes are designed to be loose laid, but with a "containment grid" underneath that limits the distance water can migrate if it should penetrate the membrane. The DTO should be dug above a grid line and the adhesion of the membrane to the substrate checked.
- If there are absorptive materials of any kind between the waterproofing and the structural deck, such as rigid insulation, cellular glass insulation, asphaltic fill, lightweight concrete topping, etc. and if there is moisture present in these materials, then an isolated repair would be of little benefit, since the moisture is free to travel to all parts of the plaza around the repaired area.

#### The Structure

- If moisture has been held against the structural deck for a considerable length of time, there may be some serious structural degradation (i.e., spalling, reinforcement corrosion). This alone may make it necessary to replace the entire membrane rather than just repair it, since all materials must be removed to expose the structure anyway.
- If the structural deck is pre-cast plank and there is no concrete topping on the plank, then a case for complete waterproofing replacement would be strengthened. Grouted keyway joints alone do not do an adequate job of tying the entire pre-cast system together, resulting in joint movement and stress on the waterproofing membrane.
- If there is no pitch to the top of the structure by virtue of either taper or slope to the structural deck, then this would also strengthen a case to com-



pletely replace the plaza system, since there is no way to introduce subsurface water management without pitching the waterproofing.

### **Bentonite Waterproofing**

Bentonite can function not only as a very effective waterproofing barrier, but also prevent water migration under another primary membrane by swelling or hydrating in the presence of moisture. Bentonite does not absorb water by capillary action, as would, say, a sponge. If you apply containment pressure to bentonite to restrict its hydration, an internal pressure is created and water molecules cannot pass through.

If the existing bentonite is observed to be hydrated, then all hydrated areas will have to be replaced with dry product, even if the original was functioning properly. This is because all containment pressure against the bentonite has been removed as a result of excavating the DTO, thereby allowing the unrestricted bentonite to "free swell" and lose its waterproofing characteristics. This may impact your decision of whether or not to repair or replace the plaza assembly.

### **Tie-Ins**

If the tie-in between two different waterproofing systems is failing, perhaps all that is needed is a new, properly designed repair at that tie-in location. However, if the tie-in is not currently failing but the two materials are incompatible over a long period of time, then you may consider changing the entire membrane on one side to a more compatible one. One example of incompatible materials would be PVC and pitch.

### **Surface Water Management**

- If the current wearing surface is so badly damaged and permeable that significant amounts of water are accumulating at the waterproofing level, then perhaps a repair approach is inappropriate, particularly if there is no subsurface water management system. Most liability-conscious owners will want to eliminate trip hazards anyway.
- If the wearing slab concrete was allowed to ooze down between the butt joints of the rigid insulation, thereby forming thin concrete "knives", then complete system replacement may be appropriate. Conceivably, these knives could be driven down into the waterproofing

membrane if the superimposed loads were sufficient.

- The location and number of plaza drains should be able to accommodate a worst-case rainfall.
- The drain should be equipped with a clamping ring so the membrane is secured.
- Have the plaza drains been "crushed" by vehicles, indicating that either bollards should be installed to limit vehicle access, or more appropriate drains should be installed?

### **Indoor Air Quality**

Depending on the test results and the amount of visual evidence, mold and mildew abatement may be necessary.

### **Adjacent Above-Grade Walls**

Sometimes a deficiency in an adjacent wall can make it appear as though the plaza waterproofing is failing, when it is not.

- If there are open joints, cracks or other openings in the wall face above the plaza, sometimes the entering water can circumvent the waterproofing and enter the building.
- Something similar can occur if a masonry cavity wall has no through-wall flashing or is weeped below the surface.
- Sometimes the source of water entry into an above plaza wall is quite evident. If windowsill flashings are failing badly, either moisture or efflorescence will sometimes appear on the brick surface.

### **Interior Evidence Can Be Misleading**

- Pre-cast plank with hollow cores can complicate a diagnosis. Water entering a pre-cast core at the location of a membrane failure can travel a great distance before it reaches the bearing end of the plank, where it migrates behind the edge flashing and enters the building interior at the top of a wall, resembling a flashing failure.
- When a long, consistent water mark on the inside surface of an expansion joint originates at the top of the wall, look closer. It may, instead, be originating from dozens of pin-size holes in the expansion joint sealant itself

running from the top of the wall down to the floor.

### **DEVELOPING RECOMMENDATIONS**

That which distinguishes a "professional" from a "non-professional" (using the terms in their broadest sense) relies in large measure on whose interests really come first, the owner's or your own. Fortunately, because of the nature of most projects, it's not an either/or situation. Usually, the recommendation that best serves the owner also best serves the investigating firm by creating a nice future design project.

However, there are times when these two interests are in conflict. It's on these occasions that the professional must bias their recommendations to the owner's best interests over their own. In other words, the leak investigation service should stand on its own merit and not become a marketing tool used to create future design projects.

Generally speaking, the recommendation made by the Leak Investigation Report will fall into one of three categories: no action, isolated repair(s) or complete system replacement.

I have provided some examples covering each of these three recommendation categories. Some are case histories and some are hypothetical.

### **No Action**

- Existing conditions: An elaborate concrete wearing slab (with decorative feature strips), sand fill, insulation, drainage board, a waterproofing membrane, bentonite, a tapered asphaltic fill directly applied to the structural deck. The entire plaza was recently constructed designed by another firm.
- Infiltration: A very small amount of water dripping steadily from a new shrinkage crack with no apparent relationship to the weather.
- Recommendation: Take no immediate action and monitor for a couple of months. Most likely a small amount of construction or rain water entered the asphaltic fill during construction before the weatherproofing was installed and was then trapped between the waterproofing and the structure. Without a vapor retarder below the asphalt, the trapped moisture entered the first available shrinkage crack that developed in the new structure. If the trapped moisture is



slight, it may drain away on its own without the owner spending any money on repairs.

#### **Isolated Repair(s)**

- Existing conditions: Wearing slab, sand fill, insulation, protection board, hot fluid-applied rubberized asphalt waterproofing directly adhered to sloped structural deck. Plaza drains are exposed on the underside of the structural roof in a room being used temporarily as a high school student lounge.
- Infiltration: Water is dripping from around each plaza drain bowl in the student lounge.
- Recommendation: Open up a small area of plaza round each leaking drain and repair the waterproofing failures at the drain clamping ring. Also, tighten the connection between the drain bowl and the structural deck. What's happening is that the students in the lounge are occasionally hanging from the exposed drain leaders, which has loosened up the connection and created movement between the drain bowl and the deck, thereby tearing the membrane.

#### **Complete System Replacement**

Existing conditions: Concrete wearing slab, sand fill, protection board, built-up pitch waterproofing membrane, tapered foam cellular insulation, structural deck. There are also two planter boxes.

Infiltration: Water is dripping from two pipe penetrations and one expansion joint. The flashing of these three details, however, is not failing.

Recommendation: Complete system replacement from wearing slab down to and including the cellular glass insulation. Built-up pitch is an excellent waterproofing membrane which lasts an extremely long time. However, apparently a grounds keeper sometimes drives stakes into the planter areas to support young trees and on one occasion punctured the membrane. The cellular glass insulation below the punctured membrane absorbs the irrigation and rain water and then the water migrates everywhere until it encounters an opening in the structural deck itself such as a pipe penetration or an expansion joint. Unfortunately, the only way to assure complete repair is to remove the water-

logged cellular glass, which probably has lost most of its thermal properties anyway.

#### **ESTIMATING PROJECT COSTS**

Everything up to this point has been devoted to revealing to the owner why the water is entering the building and what measures are necessary to fix it. However, this information alone is an academic without the costs associated with such a "fix". Estimated cost information is an essential part of a leak investigation report because it enables the owners to make an informed decision about which fix they can afford, when they can best afford it or whether they can afford it at all.

The following items can impact fees, construction costs or both and should therefore be taken into consideration when calculating estimated project costs.

#### **Prime or Consulting?**

Does the owner want you to provide prime or consulting services? This will greatly impact the extent of your service, especially during the bidding and construction observation phases.

#### **Construction Standards**

Does the owner have formal construction standards above and beyond federal, state and local codes which must be adhered to during the design phase?

#### **Code Upgrades**

Are there any ADA or other code upgrades required such as handrails, guardrails, stairs, ramps, lighting or energy loss? Legal authorities may not require certain code upgrades if the extent of construction is limited (i.e., repair instead of replacement).

#### **Special State Programs**

Will the owner require conformance to any special state legislated programs designed to bias contract award to minority or other targeted groups? This stifles competition and will increase construction costs.

#### **Liquidated Damages**

Will the owner require a liquidated damage clause in the contract? Such a clause may be helpful to the owner to assure that the contractor will complete the project on time; however, most likely the owner will pay for this assurance in higher bids.

#### **Project Size**

Will the construction value of the project be large enough to attract competitive bidding or will contractors look upon it as a small "nuisance" project?

#### **Bidding Climate**

Will the project most likely be bid at a time of the year when bidding is competitive or when it is not?

#### **Contractor Base**

Is the local contractor availability good for this type of project? If not, expect the bids and project costs to increase.

#### **Access and Staging**

How accessible is the site? Are there potential staging areas next to the site or will staging be remote?

#### **Stockpiling**

Will on-site stockpiling be permitted or will it have to be remote from the site? This usually does not affect the construction value unless the quantities are large.

#### **Seasonal Road Restrictions**

Will construction take place during a time of year when seasonal road restrictions are in effect?

#### **Fire Lanes**

Are any of the access roads immediate to the site designated as fire lanes which have to remain unobstructed. If so, this may complicate the contractor's negotiation of car, truck and equipment parking, thereby increasing the construction cost.

#### **Egress/Access Provisions**

Will the contractor have to construct elaborate temporary stairs or ramps in order to maintain egress and access during construction? As necessary as these might be, they will build additional costs into the project that will not remain after the completion of the project.

#### **Restrictive Work Hours**

Will the owner require unusual working hours to reduce occupants' exposure to noise, dust or fumes? Evening and weekend labor will most certainly increase construction costs.

#### **Construction Equipment Weight Limit**

Does the existing structural capacity of the deck put unusual restrictions on the size of construction equipment that will be allowed on the plaza during con-



struction? If so, will the habitable space below accommodate shoring to increase the size restriction, thereby reducing costs?

#### **Overhead Obstructions**

Are there any overhead utilities or other forms of overhead construction that would seriously interfere with construction cranes or activities?

#### **Adjacent Construction Projects**

Is the owner planning any other construction projects adjacent to this one? Could they be combined to reduce costs or will they interfere with each other, thereby adding costs?

#### **Plaza Drains**

If new or additional plaza drains are necessary, how accessible is the plumbing from the building interior? Are there convenient utilities to tie into?

#### **Air Intakes**

Will the contract require extra elaborate temporary construction to close off mechanical air intakes, assuming that supply air can be temporarily rerouted?

#### **Contingency Cost**

The size of the recommended contingency should reflect the designer's comfort level with the accuracy of the existing documents and the degree to which he expects "surprises" to occur once things are opened up and all existing conditions are revealed.

*David Campbell is a registered architect and manager of the waterproofing department at Inspec Inc. Engineers/Architects in Minneapolis, Minnesota.*

## *Industry News*

### **Publisher Revises Guide to Contract Documents**

The third edition of "The Building Professional's Guide to Contract Documents" provides owners, architects, engineers, design-builders, contractors, subcontractors, and students with 400 pages of information on how to prepare and use construction documents and effectively communicate construction requirements to all concerned.

The book is published by R.S. Means Co. of Kingston, Massachusetts, an AFE corporate member, who describes it as "an updated recipe for avoiding the problems that are aggravated by the new methods of project delivery."

Readers can expect to learn how to structure documents for maximum efficiency, placing emphasis on preparing specifications and technical requirements, description writing, proprietary and performance specs, and standards. The book includes coverage of the most widely used standard documents and offers guidance on making revisions to address particular project needs. New to the third edition is a discussion of the advantages and disadvantages of the various methods of project delivery, including design/bid/build, construction management, and design-build.

In addition, the book provides pointers on contract administration, including communications, transmittals, shop drawings and other submittals, mock-ups, and project closeout and payments. The text clearly defines relationships between owners, design professionals, and contractors, and examines their respective liabilities.

The author is Waller S. Poage, AIA, CSI, CVS, a practicing architect with offices in Alexandria, Virginia. Over the past 35 years, he has received national recognition for his work in regional and urban planning, corrections architecture, value engineering, and, most recently, cellular telecommunications. He is a past faculty member of the School of Art and Design at the University of Texas at San Antonio.

The book costs \$64.95 and can be ordered from R.S. Means by calling (800) 334-3509 or faxing 800-632-6732.

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## **School Sets Up National Center For Terrorism Preparedness**

The University of Findlay in Ohio has established the National Center for Terrorism Preparedness as part of its National Center for Excellence in Environmental Management. The new center's programs are geared for hospital emergency room personnel; industry, safety and security personnel; small- and medium-size city and county public service agencies and law enforcement agencies.

"This center will develop and maintain a lead role in emergency response training for acts of terrorism involving nuclear, chemical and biological weapons. These so-called weapons of mass destruction, or bioterrorism, will be the main concern of the center," according to a news release from the university. "The training will address the state-of-the-art concepts related to preparation, management and coordination of the response to a terrorist incident. This effort will build on the outstanding program in hazardous substance response and management already developed at UF."

For more information call (800) 521-1292, e-mail [nceem@mail.findlay.edu](mailto:nceem@mail.findlay.edu) or visit [www.nceem.org](http://www.nceem.org).