

Planning for Concealed Site Conditions

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SUMMARY

The discovery of unexpected ledge or other unsuitable soil conditions can derail a construction schedule and challenge a project budget with added cost. General Conditions published by the AIA and laws in some states provide that concealed conditions may require additional construction time and cost, especially if the encountered conditions differ from those described in the contract documents. While it may not be possible to know everything about concealed conditions without exposing them, there are strategies that can be used to manage the scope of construction work related to concealed conditions and to minimize the adverse effects on construction time and project cost.

A COMPLETE SITE ANALYSIS

Look into Site History (and Ask Around)

On a military project some years ago I was surprised by the contractor's discovery of an old building foundation during excavation for the new building foundation. Soil borings had been taken at several locations within the planned footprint of the new building, but the borings had missed the old foundation and basement slab that remained. As the old foundation was exposed by the excavator, curious onlookers appeared around the site. One old-timer said he remembered the old building and had watched its demolition. "Where were you," I thought, "when we were planning this new building?"

Planning for the new building had focused on a level, sandy site located among other buildings on the base. It looked perfect for the new building, except for a nice old tree that had to be removed from the new building footprint. And the borings, noted above showed clean sand. Footings were designed for the low bearing capacity of the sand. Our site maps were too new to show the old building, and we did not think to ask around about what might have occupied the site earlier. It looked clean, and we did not expect any site difficulties.

After a few similar project experiences, I concluded that a site that appears flat and clean is very likely concealing remnants of earlier construction that may

not provide appropriate support for a new building. Mother Nature has not created many level sites for building construction, and a level site surrounded by uneven topography is likely to conceal conditions that will have to be dealt with during construction of a new building.

The design team should ask around early in the design phase to learn about the site's history and obtain available historic documents and maps. The history could include buildings that are no longer visible, dumps that hold deposits of unsuitable or even hazardous materials, abandoned underground tanks and utilities, concealed water courses, and other conditions that may affect the new construction. Knowledge of site history can be very useful in planning for new construction and managing the cost and scheduling effects of concealed conditions.

Conduct a Geotechnical Investigation

An early geotechnical investigation can highlight concealed conditions that need to be either dealt with in design, planning, and management, or avoided by locating a building elsewhere. Often the first geotechnical investigation may not be the only investigation for a given project. On one school project, the initial investigation included a few test pits on a building site in the area of the proposed building footprint. The test pits revealed the presence of a thick layer of organic peat that had been covered by better material. The geotechnical engineer recommended removal of the peat from the area of the building footprint. The question then was: What is the extent of the peat, and what are the profiles of the top and bottom surfaces of the peat? The design team needed an underground map.

The owner and architect authorized the geotechnical engineer to return to the site and conduct more test pits to develop idealized cross-sections of the site through the proposed building footprint. This would allow for the contract documents to include information that would be adequate for bidders to determine the scope of removal of the unsuitable soil (peat).

Another advantage of an early geotechnical investigation is validation of the type of foundation system anticipated by the structural designer. Geotechnical information may lead to a decision to use piles and grade beams instead of spread footings, or it may lead to a decision to use a thick mat foundation system. Reviewing this information early can minimize costs associated with redesign time.

Review and Make Use of Documents Related to Earlier Construction

Renovation projects—or even new building projects—may occur on sites where previous construction was documented. It is useful to consider the information that can be found in existing building drawings and specifications. Original building construction and subsequent additions and renovations may have included documentation of existing site conditions at the time of that construction. Site work drawings may have indicated existing (now preexisting) grades and the addition of fill to achieve the then-proposed new finish grades. A geotechnical report may determine that the previous fills were not compacted and must be removed and replaced with appropriate fill for the new project. In some cases it is practical to develop a mass excavation plan which shows the depths to which mass excavation is required to remove existing fill material in order to develop an adequate base for new construction. Such a plan, if well developed, can take the mystery out of bidding the removal and replacement of existing fill. Unit prices can be developed to allow cost adjustments to agree with the actual quantity removed if it is determined by the geotechnical engineer during construction that the limits of mass excavation can or should be changed.

Beware that Multiple Unsuitable Conditions May Exist on a Site

Finding organic peat on a site does not mean you will be free of other concealed conditions. On the school project cited above where idealized profiles were developed to manage the removal of organic peat, planned athletic fields were affected by the discovery of ledge in several areas.

Initial geotechnical investigation in the areas of proposed athletic fields had been limited by terrain, tree cover, and snow cover. A track-mounted excavator was used, and the depth of exploration was limited to about eight feet. Although ledge was suspected in the area, the investigation did not reveal any ledge. As the site design considered newly surveyed topography, it became necessary to reduce the number of fields and develop a tiered

design including 20-foot banked steps between fields. The required excavation for these fields was much deeper than eight feet below existing grade, and ledge exposed during construction led to a negotiation over additional site work costs, a redesign of the fields to minimize the additional costs, and a dispute that remained unresolved until it was settled through mediation at the end of the project.

Include Budget Contingencies for Concealed Site Conditions

Project experience highlights the importance of including budget contingencies for concealed site conditions. Although project contingencies are rarely detailed by category of work, the development of a contingency should consider the likelihood of encountering concealed conditions that will have to be dealt with through added cost change orders, whether the change orders are based on unit prices established prior to or at bid time or are negotiated without unit prices.

The removal of peat from the school building footprint in the project above was estimated to cost in excess of \$250,000, and the ledge removed as change order work added approximately \$400,000 to the cost of the project. The peat removal was included in the scope of work to be bid, but the ledge removal took more than one-half of the 5 percent contingency for the \$15-million school project. It is easy to see how the cost of dealing with concealed conditions can loom large on a project, make everyone nervous and testy, and lead to disputes that cost more than just getting the work done.

Include Unit Prices and Quantity Estimates

Including unit prices and quantity estimates in bid documents can help to minimize the disruption caused by uncovering concealed site conditions. A quantity estimate can be established for bidding purposes, and unit prices can then be used to cover (or credit) cost adjustments to the quantity that is actually encountered. Unit price development should carefully consider and describe the conditions anticipated and everything that must be covered by the unit price (e.g., removal and legal off-site disposal, proper placement and compaction of new fill, and quantity based on in-place volume).

On the school project above, “in-place” measurement became a very important principle as the contractor made and then moved piles of removed ledge rubble and then sought additional payment for various piles (here one week and over there the next week). On another project, the owner’s clerk agreed to count truckloads of removed

material, and he then had to count them all day long and inspect each one to estimate the quantity based on the capacity of the truck. The methodology proved inaccurate and only served to fuel a dispute.

Define Terms

As with truckloads of material, it is also true that people can interpret “ledge” to mean different things. In many cases, the transition from glacial till or other easily removable material to ledge is not abrupt. Weathered ledge—a crumbly surface—can often be removed by standard excavating equipment without blasting or employing special equipment. Specifications should define ledge in terms of the required removal procedures in order to reduce the chance of disputes regarding the limits of ledge.

In the case of the school project cited above, the transition to ledge included a three-foot-thick layer of weathered ledge material that could be removed by standard excavating equipment. The architect, who was able to remove this material with hand tools, rejected the contractor’s first claim that the top of ledge had been established. The contractor excavated deeper with equipment already on site, and then a procedure was established for surveying and quantifying the actual ledge material that had to be removed to allow for athletic field construction.

Coordinate Construction Documents to Avoid Inconsistencies

When it comes to unsuitable soil and its removal, it is important that the construction documents are consistent. Site work specifications, site work drawings, structural specifications, structural drawings, “front end” specifications, and unit price specifications should all be coordinated in terminology and should not include contradictory information that may contribute to a dispute regarding the contractor’s scope of work. Further, these documents should be in agreement with the terminology used in the geotechnical report, such that terms related to soil materials have the same meaning. Gravel, fine gravel, crushed gravel, slab base course material, granular fill, and structural fill should not be used interchangeably, but should be coordinated among the drawings and specifications such that each term represents only one set of properties and gradation. It is unfortunate that young professionals are sometimes given authority on a construction site without knowing the difference between gravel and crushed stone or other commonly used materials.

Monitor and Document Removal Activities Full Time

Monitoring of the removal of unsuitable materials is not the place to save money on a construction project. The monitoring and recording of activities is especially important where cost is based on the quantity of material to be removed and replaced. It is also often necessary to obtain an independent survey of the top of unsuitable material and then a survey of the bottom of the excavation (the bottom of unsuitable material) in order to establish and agree to the quantity of material actually removed. On one project where the contract documents established contractor responsibility for removal of an area of organic peat, the contractor said that since he “owned” the removal anyway, the geotechnical engineer did not need to monitor the removal work. The geotechnical engineer did not return. Later, the contractor disputed the quantity of removal, and the owner and architect did not have daily reports from the geotechnical engineer to use in resolving the dispute. That made it difficult to argue against the contractor’s claim that he had removed “a lot more” than the estimated quantity. The saved cost of full-time monitoring was insignificant compared to the cost of the contractor’s claim and the cost of defending against it.

Prepare and Approve Timely Change Orders to Keep the Project on Schedule

Many people have a tendency to put off paperwork. They would rather shake hands on a deal and take care of paperwork later. However, cost and time issues related to concealed site conditions may not be completely evident soon after discovery, and a dispute may emerge later and include a delay claim if timely construction change directives or change orders were not written and approved. Recall the case of the geotechnical engineer who stopped monitoring excavation on the contractor’s advice, only to find later that the contractor had submitted a claim disputing the original estimated quantity of unsuitable soil.

One reason to process timely paperwork is to avoid memory loss. It is easier and more accurate to document agreed conditions when the event or subject is fresh in your mind.

Allowing weeks or months to pass can lead to disagreement as parties to the original agreement produce different recollections of procedures, scope, terms, costs, and schedule. So it is better to get the paperwork on the table quickly and to shake out any residual disagreements before they influence the ongoing work and relationships among the project team.

Another reason to process timely paperwork is that construction projects usually involve subcontractors who may not be present for a handshake; a timely change directive or change order is likely to reach them more quickly than word of a handshake. So do not put off the paperwork. And, if an owner or building committee is hesitant about approving a change order for legitimate extra work, the reasons above should be enough to convince them of the practicality of timely paperwork.

Learn from Experience: Improve Procedures for the Next Project

Experience with concealed site conditions grows from project to project. The conditions described above may occur on other projects, and other conditions may occur. Every project that involves site work is likely to provide a new experience that can help to shape better construction documents for future projects and to help minimize the adverse effects of concealed conditions that are different than expected. Confronting these experiences allows for and supports improvement. An ostrich-like head-in-the-sand approach, on the other hand, may lead to reruns of bad experiences.

Consider All Construction as Renovation (or Alteration)

One final way to help increase the awareness of existing conditions that may affect a project is to consider that all construction is really renovation (or alteration). Even a new building requires renovation of an existing site, and there may be other effects and relationships to consider, whether or not these considerations are required by law or by permitting authorities.

About the Contributor

Albert R. Russell, AIA, CSI is an independent consultant and a licensed architect with more than 30 years experience in architecture, project management, and construction administration. His independent consulting work includes a focus on project management and dispute resolution.

RESOURCES

More Best Practices

The following AIA Best Practices provide additional information related to this topic:

- 11.06.01 Mold: A Design Checklist
- 11.04.06 Effective Methods of Site Safety
- 11.10.01 Understanding Human Behavior Leads to Safer Environments

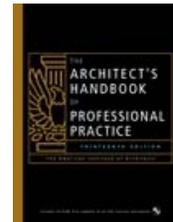
Feedback

The AIA welcomes member feedback on Best Practice articles. To provide feedback on this article, please contact bestpractices@aia.org.

For More Information on This Topic

See also "Site Analysis," by Floyd Zimmerman, FASLA, *The Architect's Handbook of Professional Practice, 13th edition*, Chapter 17, page 529.

See also the 14th edition of the *Handbook*, which can be ordered from the AIA Bookstore by calling 800-242-3837 (option 4) or by email at bookstore@aia.org.



Key Terms

- Design
- Preliminary design
- Site analysis
- Environmental analysis