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From start to finish, mind your dirt

Developers hoping to build a multi-million dollar office building or retail development are generally not thinking



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about dirt and with good reason. Their time is filled with permitting, building design, square footage, return on investment, target tenants and interior

design.

Geotechnical testing and engineering is often an afterthought. At some point between initial conceiving and the start of construction, a geotechnical and/or environmental engineer is brought on to the project. However, bringing the engineer in too late in the process may result in added cost because of design changes needed to compensate for geotechnical issues. Instead, geotechnical considerations should be a forethought and engineers brought in during the early planning stages of the project.

Geotech 101

Geotechnical engineering is commonly an afterthought because in many cases it is poorly understood. Yet in Colorado, geotechnical analysis is particularly critical. Our state has higher incidents of expansive soils than in other states; in some areas soil increases in volume by

as much as 15 times its original size. Expansive soils are a problem that can cause damage resulting in the billions of dollars – costlier than damage from tornadoes, hurricanes, earthquakes and floods combined.

But geotech covers more than just expansive soils. A geotechnical engineer can help address vapor transmissions through slabs, shallow groundwater and slope stability among other potential geologic hazards. It is the owner or developer that hires the geotechnical engineering firm for the project, but not unlikely for the architect to recommend a company they have worked with in the past.

Dirt Before Design?

Architects and developers may think it is premature to involve a geotechnical engineer before preliminary design, but there are a number of benefits in doing so. The earlier a geotechnical engineer is involved, the more certain the architect can be in his or her designs for a project. Additionally, it is possible that having a geotech consulting from the start will result in considerable cost savings through time saved and realistic design. A preliminary soils investigation can identify site specific issues such as groundwater, environmental issues, expansive soils, existing fill or debris fill which may be remedied through strategic placement of the building

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footprint. The sooner a geotechnical engineer is involved in the project, the earlier the architect and their design team can appropriately develop the structural design. Moving forward, the soils engineer can do additional studies, ultimately recommending alternative foundation systems and other measures to address site issues.

From the foundation system, dewatering issues, mitigation of expansive soils and seismicity of a site, geotechnical studies lessen risk. For example, if plans call for multiple levels below grade, groundwater must be evaluated and shoring or bracing of the excavation considered. Proper investigation should help in creating a realistic design based on known subsurface conditions, thereby allowing the project to move forward with reliable information instead of guess work.

Beyond site assessment, geotechnical engineering firms often offer other services such as environmental assessment studies and materials engineering and testing. These services can be as critical to a project's success; geotechnical evaluations, in fact, are required in some cases.

Contaminated soils may create cost impacts that should be addressed sooner than later, and many financial institutions will require an environmental assessment before the project is fully financed. In some cases, an environmental study may be available from the previous owner. Although this study should not be relied upon as an independent assessment, it may provide leverage in negotiating the site's sale. For projects involving an existing structure built before 1971, owners and

architects will also need to consider environmental assessments that include tests for lead paint or asbestos.

Geotechnical engineering firms can also help during the construction phase of a project, providing construction observation and materials-testing help to verify whether the contractor's methods and materials meet project specifications. In order for a building to come to completion and receive a certificate of occupancy, materials testing must be documented during construction.

Valuable Engineering

Geotechnical tests are often seen as an unnecessary cost. However, the return on investment for these tests can be monumental – particularly if long term problems are mitigated.

Compared to overall projects costs, these tests are relatively small. A geotechnical investigation may run anywhere from \$2,000 for a simple test to \$20,000 or more for a difficult or complex building project. Environmental assessment studies cost between \$1,800 and \$3,000 depending on the size of the property and level of investigation needed. In the end, having accurate information on which to base design leads to more realistic budgets.

To maximize efforts, it is preferable to have the same company provide all of the services – geotechnical, environmental and construction observation and materials testing. In particular, the geotechnical firm that provided the design level soils report should perform construction observation,

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allowing them to assess whether conditions exposed during the construction are consistent with those indicated by the geotechnical investigation.

For architects wanting to know more, the American Institute of Architects sponsors continuing education units (CEUs) led by approved geotechnical engineering firms. Topics may include how to read and interpret a geotechnical report, how to determine when geotechnical testing is appropriate, questions to ask a geotechnical engineer and when to obtain a second opinion.

The design team and owner need to be comfortable with the level of investigation performed, and if unsure, ask questions of the geotechnical engineer on record or even obtain a second opinion.

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