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Consultants Corner

Engineering for the future

Being Green Starts At The Ground

The concept of green building has been around for years, but had not made it to the mainstream building industry until recent times. Whether it is the awakening of our culture, legislation or newfound media attention, the term "green" is on the forefront of people's minds. The recent interest in green building (sometimes referred to as "low impact development" or "sustainable design") has given rise to the need for geoprofessionals to address the potential geotechnical impacts of green practices on projects. While these practices may increase the "greenness" of a project, unforeseen detrimental consequences may arise as a result of such practices.

Several organizations have sprouted as a result of the green building revolution. Type "green building" into a Google search and the results are staggering. Organizations such as the U.S. Green Building Council (USGBC) have helped educate and promote green building practices. A certification program developed by the USGBC called Leadership in Energy and Environmental Design, commonly known as LEED, has practically become a household term. The organization has developed various levels of certification—gold, silver and platinum. These are based on a point system that reflects aspects of a project's design.

What exactly is green building? It is a result of project design that focuses on increasing efficiency of resource utilization while attempting to reduce a building's impact on humans and the environment during its lifetime. Efficient utilization of water, energy, building materials and other resources are goals of green building. Reducing the amount of waste and consumption of natural resources during and after construction is crucial for future sustainability. These concepts challenge designers to look for uncommon solutions to common problems.

Photo provided by Wallace Group

Installation of infiltration basins along the edge of a roadway.

From a geotechnical and construction materials engineering standpoint, there are numerous measures that can be incorporated into a project to enhance its sustainability, such as taking advantage of natural site topography or favorable soil or groundwater conditions. Existing construction materials can be recycled for use in new projects. While these measures result in undeniable benefits from an environmental perspective, they can also present technical challenges.

What to do with storm water? Mandates by local and state agencies have reduced or eliminated the amount of storm water that is allowed to flow off of a site. As a result, on-site storage and disposal of storm water has become a hot topic. Underground detention basins, dry wells, permeable pavers and leach fields all entail subsurface improvements that provide a conduit for storm water to be infiltrated into the soil. For sites with an appropriate design layout and suitable soil conditions, the systems can be of significant benefit to the project by allowing non-visible storm water disposal while increasing the available space for landscaping, pedestrian use or parking.

On paper, these systems may seem like

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the perfect solution to designer's storm water woes; however, several aspects of such systems should be analyzed prior to implementing their use. Placing systems in close proximity to foundations could lead to saturation of the surrounding soil, eventually reducing the strength of soils that are intended to support the building's foundation.

Another crucial aspect to consider is the placement of these systems in relation to the surrounding topography. The systems should not be placed near slopes or improvements where the concentrated introduction of subsurface water would be detrimental. For example, placing a system at the top of a slope could lead to slope failure if soils become saturated. The subsurface soil conditions also need to be considered before utilizing a subsurface system. Fine-grained soils (i.e., clays and silts) generally will not allow infiltration of water, while coarse-grained soils (such as mixtures of sand and gravel) will generally allow water to infiltrate back into the ground. Geoprofessionals can provide the necessary geotechnical guidance to assist in the development of on-site storm water disposal systems that are appropriate for the site conditions.

Another green building aspect to consider is how the site will be graded and what types of foundations will be used. Reducing the size of a building's footprint and the amount of area that is disturbed promotes the green building concept. As soil and bedrock conditions often dictate the amount of earthwork and foundation types necessary for development, a geotechnical investigation is a crucial part of the design stage of a project.

For instance, loose or soft soil sites are often overexcavated and recompacted to specified depths to mitigate settlement potential. If this approach is not consistent with the desired project design, alternatives could be to reduce the building footprint and increase building height, or select an alternative foundation such as piles or a rigid mat.

Utilizing recycled or waste materials in construction is another way to enhance the greenness of a project. From a construction materials engineering standpoint, utilizing recycled asphalt and concrete for aggregate base, high fly ash concrete mixes and grinding of roadway materials are time proven methods that reduce a project's impact on the environment.

Portland cement is the most common type of cementitious material used in concrete. The transport and manufacture of Portland cement is energy intensive. An alternative cementitious material is fly ash, which is a waste product of the coal industry. Replacing a percentage of Portland cement with fly ash in concrete mixes is a relatively easy way to use a waste material in the construction process. Fly ash increases workability and overall ultimate concrete strength, generally costs less than Portland cement, improves concrete resistance to sulfate attack and reduces the heat of hydration. Drawbacks, however, include increased time for the concrete to cure and sometimes lower early strengths, which can slow the construction process.

Other recycled construction materials associated with civil site development include aggregate base, asphalt and erosion control products. Recycling existing pavement materials at a project site, such as grinding asphalt concrete to be used as aggregate base, reduces the need for virgin materials, and ultimately increases a project's sustainable or green nature.

Green building techniques in the field of geotechnical and materials engineering continue to evolve with new products and concepts. Green design practices are becoming more common as the public places a higher value on environmental stewardship and efficiency. The Earth Systems group of companies is committed to an active role in sustainable development, continuing education, listening to clients needs and adapting to new ideas and concepts that are important for the future of our profession and, ultimately, our planet.

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