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Site Investigation – A UK Perspective in the 2020s

What is Site Investigation?

Site Investigation is the whole process for examining and obtaining information on the ground and groundwater conditions beneath a site.

Whilst no Standard can entirely prescribe the scope and extent of investigation required for any development, the UK and European standards, developed over many years, give excellent comprehensive and inclusive guidance on this. A 3-stage approach to site investigations is recommended including:

1. **Desk Study** – collection of existing information and site reconnaissance to provide a high-level understanding of ground conditions. Useful for outline design at feasibility stage, and to inform the scope of the detailed investigation.
2. **Detailed Investigation** – including intrusive “ground investigation” to indicate ground conditions, and laboratory testing to define characteristic soil parameters.
3. **Construction Review** – Confirmation or amendment to understanding of the ground engineering design based on as-encountered conditions. This includes observation and quality assurance testing/monitoring.

Unforeseen Ground Conditions Still Exist

It is usual for the Employer to undertake a site investigation as part of the initial design phase.

Irrespective of the form of contract (e.g. design & build; design-bid-build), to varying degrees construction contracts attempt to pass responsibility for ground conditions from the Employer onto the Contractor, with reliance being on what a competent contractor might reasonably assume from the information provided.

There is no, and probably cannot be, consensus on what is reasonable in this respect, and when it comes to dispute reliance on contract clauses that pass over ground condition responsibility to the contractor becomes something of a lottery.

For instance, is it reasonable for a contractor to consider that the ground conditions are fully described in the Employer’s pre-tender site investigation? Or is it reasonable for a competent contractor to have an insight beyond the Employer’s site investigation, or undertake its own due diligence? Either way, the definition and demonstration of what is reasonable is going to vary for every site. By example, a literally identical pre-fabricated hotel design used on two different sites is likely to require different levels of investigation, and what is reasonable on one site may not be on the other.

Alternatively, consider a residential development extending over several hectares on a greenfield site with good ground conditions anticipated. It would be quite normal (and therefore reasonable) to undertake a site investigation including exploratory holes on, say, a 50m grid pattern. However, by so doing only about 0.04% of the soil relevant to the engineering design is sampled. The sub-samples that are tested in the laboratory will constitute about 0.00002% of the soil.

Turning this on its head, that 99.96% of the ground is unknown may not appear so reasonable.

When things go awry, based purely on the extent of intrusive work, different appointed geotechnical experts may correctly and quite legitimately describe almost any site investigation as either reasonable or unreasonable. However, the level of attention and skill provided to the interpretation by the Contractor's geotechnical engineer comes to the fore where this takes cognisance of all available information, including qualitative (desk study and walk over survey) and quantitative data.

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Development of Site Investigations in the Noughties

Experience gained within the industry over the years has led to UK developers having a good understanding of the benefits of site investigation. Yet it remains the case that issues of unforeseen ground conditions arise, and the adequacy of the site investigation is invariably brought into question.

Determining commonality between different sites is never going to be straight forward for the very reason that ground conditions are so variable. Further, some trends that can be seen are more man-made than ground related.

As the requirement to utilise brownfield sites for development has increased over the last two- or three-decades, issues of ground contamination have become increasingly prevalent. This is reflected in the attention placed on contamination by planning authorities.

Planning Conditions invariably, and rightly, include for attention to be given to the definition and appropriate treatment of contamination as a necessary part of the development of sites. Developers are very aware of this and require the site investigation to adequately address these issues to smooth the planning process.

Possibly resulting from local authorities' divestment of building control responsibilities to third party organisations (e.g. NHBC), a similar emphasis tends not to be included for geotechnical considerations. Arising from this, it has become normal for the Desk Study to be exclusively geared towards contamination issues. This probably arise due to the common wording in planning conditions requiring a Preliminary Conceptual Ground Model of the site relating to contaminated ground.

Following into the interpretation of the detailed ground investigation, attention to contaminated ground issues is likely to occupy an overwhelming predominance in the report text. For those of us who have compiled or read many site investigation reports, the text used at the site investigation stage tends to be very similar whether there are contamination issues or not. Complications of contaminated ground tend to be addressed with further focused intrusive investigation followed by remediation.

It is especially noticeable with investigations for small and medium sized developments that geotechnical issues are often relegated to a series of

short paragraphs each providing a comment on, say, building foundations, road foundations, earthworks, retaining walls etc. with little or no explanation on the basis for or limitations of such recommendations. Whilst issues of ground contamination do arise in disputes, in my experience these are (numerically at least) insignificant compared to geotechnical related claims.

In the early years of the routine inclusion of contaminated ground studies as part of site investigations, it was a convenience for geotechnical engineers to drift into the new science, which initially required little specialist knowledge to follow through the limited guidance that was available at the time.

In 2002, with the introduction of the Contaminated Land Exposure Assessment (CLEA) framework, it became clear that dealing with contaminated land was no longer going to be an add-on skill for the geotechnical engineer. The site investigation industry recognised this, and environmental scientists were increasingly established as an integral part of the site investigation process.

However, all too often this appears to have come about at the expense of detailed and knowledgeable consideration of the geotechnical issues at sites.

A common misconception appears to have developed in certain quarters that automation can fulfil the engineering interpretation, especially with respect to use of pro-forma report styles, and reliance on software in the determination of common recommendations, such as bearing and pile capacity. Other aspects especially relating to earthworks parameters and road foundations are commonly reported in a generic fashion based on few test results that do not necessarily reflect the wider ground conditions at a site.

The Outcome in Disputes

Despite the ready availability of some of the world's best guidance, and a generally informed and responsible approach from developers, there remains a common occurrence of earthworks and foundation issues arising in disputes. These issues may be avoided (or at least forewarned) if consideration of the potential geotechnical variability is appropriately forecast at the desk study stage, and location of the intrusive investigation tailored towards this variability. Additional investigation of contamination hot spots identified from the initial intrusive investigation are quite routine, yet it is far less common to re-visit site to further investigate geotechnical anomalies.

When dealing with matters arising in disputes it is often a simple task to draw attention to such issues. A rather different skill is required to pick them up during the site investigation, and one that is not served by non-specialists filling blank spaces in a pro-forma report, nor by blindly inputting values into pile capacity software, without cognisance of the geological conditions and processes that may, and so often do, radically impact on the recommendations given.

Research in 1972 showed that the average site investigation represented 0.21% of the capital cost for developments (the range for buildings was 0.05% to 0.22%, and earthworks 0.5% to 2%). Despite the addition of geo-environmental aspects into site investigations in recent years this remains little changed today. Whilst this undoubtedly reflects benefits of automation it also indicates a reduction in geotechnical input over time.

It is especially the case for small and medium scale developments, that cost is an over-riding consideration for site investigation contractors and success at tender can come down to only a few pounds. In this, clients have a role to play and need to always be aware that the site investigation serves a vital design function and is not just a document to placate planning officials. The inclusion of a fully detailed geotechnical discussion in site investigation reports does not necessarily require a significant (or any) increase in cost, but it does require input from a sufficiently qualified and experienced geotechnical engineer.

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