The ground – how structural engineers can manage the risk

Dr Derek Egan, Chief Engineer, Keller Engineering,
discusses the results of a recent survey by the Federation of Piling Specialists

The biggest risks facing construction projects and housing developments are those within the ground. Are structural engineers helping clients managing their exposure to these risks effectively?

In many cases the answer is a resounding 'NO', according to a recent Federation of Piling Specialists (FPS) Survey.

It would appear that some clients are not being made aware of the link between appropriate site investigation and successful, problem free and cost effective foundations. This could be costing the construction and building industry millions of pounds every year.

What the survey found.

The FPS (whose members undertake around 80% of the country's piling and ground improvement contracts) discovered in a survey of over 220 projects, that in a third of cases optimum piling or ground improvement solutions could not be provided.

The survey identified the following significant deficiencies, most of which could be easily remedied by structural engineers insisting that the investigation process is carefully planned, specified and supervised.

- The most basic information was frequently missing. Information freely available was often not passed to the contractor (in 17% of contracts borehole location plans were not provided, rendering useless any borehole information).
- 20% of piling contracts had no boreholes.
- In nearly 60% of cases there was inadequate topographical information.
- Rarely was a proper geotechnical Desk Study undertaken.
- In more than half of the projects surveyed environmental concerns dominated the investigation at the expense of the geotechnical element which was often compromised or absent.

Ground risk management in real world

Experience over many years has shown that without adequate ground investigation clients and their technical advisors are always exposed to the risk of costly delay, redesign and late project delivery arising out of unforeseen ground conditions. FPS members know this. While clients usually end up paying the lion's share for inadequate investigation, their technical advisors can also end up expending their own resources, and in extreme cases even paying the bill, to sort out problems.

Inadequate investigations can cost in a number of ways:

- By the contractor adding 'risk money' to his price to cover his ground risk. This will probably be more than the cost difference had an adequate investigation been done in the first place.
- Additional expenditure of technical resource (possibly unpaid) as well as the delay costs arising out of unforeseen conditions.
- In the extreme, expensive litigation may result from unforeseen ground conditions claims. Bitter experience shows that the expense of pursuing or defending a dispute can dwarf the cost of having an adequate investigation done in the first place.

In reality very few 'unforeseen' ground conditions can be claimed to have been truly unforeseeable. If this is the case then the client is entitled to ask his/her technical advisors why they sanctioned an investigation that was insufficient in revealing the prevailing ground conditions.

The knock on effects of delay, loss of revenue and business credibility affects all parties, not just the geotechnical contractor.

Why the problem?

Virtually every structural engineer knows that the ground is unpredictable and will always present a risk unless adequately understood.

It would be unthinkable to proceed to a medical diagnosis leading to surgery without adequate specialist consultation and targeted medical tests. Yet the complex issue of foundation design is frequently approached in an *ad hoc* way without timely reference to specialist advice or appropriate investigation.

Procuring site investigation on price

Site investigations which are procured on price (possibly because those involved in making the procurement decisions do not understand the subtle difference quality has on the output of competing proposals) are often poor value for money.

There may be a differential of only £1000 between a well supervised high quality investigation and a poor one, yet the impact on final foundation costs can be 10 times this differential.

As we have seen from the above, the client will usually end up paying many times this amount as the foundation solution is priced to include for the residual, un-quantified, ground risk remaining following the cheap investigation. If unforeseen conditions are encountered the financial penalty can be huge.

Poorly specified site investigation

Many site investigations are poorly specified leading to unbalanced emphasis between the geotechnical and environmental effort.

Inadequate matching of the scope and techniques used in the investigation, with the proposed development and its anticipated foundation solution, is another common problem. This may arise from the failure to understand that site investigation needs a phased approach. A preliminary investigation carried out before a speculative land purchase will rarely provide adequate information for optimum foundation design.

A properly specified and balanced investigation is essential to success. Every stage in the investigation process, from the initial desk study through intrusive investigations, soil sampling, testing, reporting and interpretation, is crucial and must be undertaken by suitably qualified and experienced people. Lack of attention to the quality of the output from any stage will introduce technical risk and therefore cost risk to a project.

Savings in the final foundation costs and reduced exposure to ground risk generated by undertaking adequate investigation can exceed by many times the cost difference between a good and a poor investigation.

Structural engineers – adding value to the *status quo*

So how can structural engineers improve their service to clients and reduce their own liabilities at the same time?

- They must ensure that they have the appropriate expertise to advise on the geotechnical matters relating to the project in hand. This can quickly be confirmed by involvement of specialist foundation contractors as soon as possible in the life of the project. This will help the structural engineer identify if additional geotechnical expertise needs to be deployed on the project.
- To avoid professional liability they must ensure they are following best practice guidance relating to the design, specification and supervision of the site investigation process (for example BS 5930:1999 *Code of practice for site investigations*[2], NHBC Standards, BRE guidance and other freely available guidance on the internet see websites: (www.fps.org) and (www.ags.org.uk).
- They should recognise that adequate site investigation usually requires a phased approach, and must be carefully designed, specified and supervised to obtain information relevant to the foundation solution proposed.
- They should recognise that procurement of site investigation on the basis of price will almost inevitably lead to poor value.
- They should ensure that all of the site investigation information obtained is communicated to all of the relevant parties within the supply chain.

Conclusion

Risk can be accepted, transferred or managed, it cannot be ignored[3]. The client (or their funder) owns the ground on which any development is built, the risk will be in the ground whether it is managed or ignored. The structural engineer is uniquely placed to steer this process – and has an obligation so to do. By ensuring ground risk is effectively managed the structural engineer can optimise his/her value by contributing to the development of cost effective safe solutions while reducing the potential for poor value foundations and costly 'unforeseen' conditions claims.

The message is clear. Ensure your client is properly advised; get the right specialist advice early in a project; and make sure the ground is adequately investigated. The benefits of doing this can be considerable.

- Full details of the survey can be seen on the Federation of Piling Specialists website (www.fps.org.uk). se

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