

A Comparison of Site Investigation Practice in the UK and Queensland

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Summary: A number of differences in specific areas of site investigation practice in the UK and Queensland are identified and discussed. These include, the use of desk studies, soft ground drilling, the procurement and the specification of site investigations. The main difference is perhaps the manner in which site investigations are procured, and it is concluded that this has probably resulted from the way the industries have evolved in the respective countries.

1 INTRODUCTION

Following a recent secondment to Arup Geotechnics' Brisbane office from Leeds in the UK, a number of differences in site investigation practice have been observed. This paper examines these differences from the desk study stage to the production of the interpretive report. In addition, the relative merits of the different approaches are considered and discussed. The paper is not an industry wide survey but a more personal observation of the author, reflecting his experience of working within the same organisation in two different countries.

2 DESK STUDIES

There are certain aspects which require different treatment at the desk study stage. Site investigations in the UK tend to be carried out on sites that have previously been developed. This is especially true of city centre sites where there may have been development dating back to medieval times and beyond. The need for detailed desk studies is therefore treated as a matter of course in the planning of investigations in the UK. A typical desk study would cover the following aspects:

- A site description including the results of a walk over survey;
- A history of the site;
- The geology of the site;
- An interpretation of the aerial photographs;
- A discussion on potential contamination;
- A description of previous investigations carried out on or nearby the site, if any;
- Recommendations for the site investigation.

2.1 History

This is traced through a number of different sources, the most abundant of which are maps and aerial photographs. In the UK there is a long history of detailed mapping which covers the main period of industrial expansion in the late 19th century and early 20th century. In the post Second World War period there is also frequent aerial photographic information which coincides with the last major phase of industrial expansion and then the contraction and dismantling of many industrial areas. For early industrial there are more fragmentary records in the form of private surveys and contemporary records.

2.1.1 Maps

Principally, in the UK, maps fall into two categories: Ordnance Survey and non-Ordnance Survey. The Ordnance Survey began publishing maps in 1804 at 1" to 1 mile scale. Larger scale maps are, however, of more interest for a desk study i.e. at 1:10560 (6" to 1 mile) and 1:2500 scales which show considerable detail. Most OS large scale 1st edition mapping starts from the 1860s and 1870s. 1:2500 scale maps show considerably more detail and exist for all settled areas from the 1860s and 1870s. Usually there are three and sometimes four pre-Second World War editions at roughly 20 year intervals. The maps are readily available either from the Ordnance Survey themselves, at the British Library (in London) or through the reference library local to the site.

Non-OS maps cover all privately commissioned and speculative mapping and pre-OS mapping. The accuracy, quality and scales vary with such maps. The principle maps of interest include early town plans, parish tithe maps, fire insurance plans and mine plans. These maps are generally found in municipal and county archives.

Maps from different periods are available for most areas of Queensland. However, regular mapping of the same area for a number of different dates may only be available for urban

centres such as Brisbane and the Gold Coast. It is therefore more difficult to trace a relatively reliable history of a particular site with these large gaps in information.

The first period of extensive mapping in Queensland was carried out by the Australian Army in the 1930s and 40s at 1" and 4" to 1 mile scales. The next major period of mapping commenced in the 1960s and has been ongoing ever since. Early cadastral maps dating from about the 1860s are held in the State Archives, but these are of limited value when tracing developments as they only really show property boundaries.

A fairly extensive amount of historical information and maps are available for Brisbane, but a large number of different sources have to be checked (for completeness): Brisbane City Council's (BCC) Heritage Section, the Department of Environment's Heritage Unit, the John Oxley Library (part of the State Library) and the State Archives.

2.1.2 Aerial Photographs

Aerial photography provides a more detailed record of the landscape than topographic mapping. The entire United Kingdom was flown in the three years following the Second World War. Since then there have been several smaller blocks of cover which in an ad hoc way provide at least one additional date of cover and in urban and industrial parts of the country upwards of a dozen dates of aerial photographic cover from the late 1940s to the present. This is all vertical cover which can be viewed in three dimensions through a stereo scope. Scales are typically from 1:3000 to 1:10000.

Aerial photographs are available for most areas of Queensland from the 1940s. Brisbane and the Gold Coast are particularly well covered for a number of different dates and scales. In addition, as a result of the work of the Beach Protection Authority, the whole of the Queensland coast has been photographed at least once in recent years. In general photographs of 1:12000 scale are available for coastal areas, 1:25000 for inland areas and 1:40/80000 for central areas of the state.

Orthophotos, which are 1:10000 vertical aerial photographs with contours marked on them are available for the Moreton Bay area (around Brisbane). These do not allow for stereo viewing, but are a very useful nonetheless.

The Department of Natural Resources in Brisbane hold the most complete record of photographs although there are a number of private companies which have their own collection.

2.2 Geological Maps and Memoirs

Complete coverage of the UK is available either at 1:50000 scale or at 1" to 1 mile (1:63360). 'Solid' and 'drift' editions are generally available. The 'solid' editions show the bedrock types only whereas the 'drift' maps show the nature and distribution of glacial, alluvial and other recent materials in addition to the solid geology. Most areas are also covered by 6" to 1 mile (1:10560) which contain much more detailed information and

even include brief details of deep boreholes and wells. There are a series of Handbooks of British Regional Geology for England, Wales and Scotland which describe the general geology of each region. For more detail there are memoirs available for many of the 'one inch' sheets. These were written by the geologists who first produced those maps. The smallest scale maps available Queensland are at 1:100000, although map commentaries (the equivalent to the handbooks available in the UK) are available for some of these.

2.3 Other Geotechnical Data

Other sources of geotechnical data include mining reports and borehole information held by the British Geological Survey. On behalf of the Department of the Environment, Arup Geotechnics have produced a "Review of Mining Instability in Great Britain"¹ which provides information on areas of potential instability due to mining and is usually referred to. For coal mining areas in particular, reports are available from the Coal Authority.

Another good source of information is the British Geological Survey (BGS), which keeps a database of borehole records for the entire UK. There is an obligation to supply borehole records to the BGS on completion of site investigations. For a small fee, a search can be conducted and copies of the borehole records made available.

Unfortunately, there is no such body mandated to collect borehole data in Queensland, although some public bodies like Main Roads and Queensland Rail, do hold a certain amount of geotechnical information.

2.4 Contamination

A large number of site investigations in the UK are being carried out on sites that have previously been developed. A useful by-product of a historical desk study is that by tracing the development of a site it could also identify potential sources of contamination. This has become increasingly important and contributes to vulnerability reduction for site workers, plant and structures by identifying possible hazards in advance of the work.

2.5 Summary

Desk studies are carried out as a normal precursor to a site investigation in the UK. There is a vast amount of readily available historical and geological information for the majority of areas in the UK. Because of the scale of mapping (topographic and geological) and aerial photography, a considerable amount of detail can be gleaned at desk study stage. This is probably the reason why desk studies play a considerably more important role in the planning of site investigations in the UK.

3 INVESTIGATION TECHNIQUES

In general the methods adopted in the fieldwork and laboratory testing are essentially very similar. The way in which soils and

rocks are logged is, however, slightly different according to the respective code of practice for each country. The main area of difference is with regard to the soft ground drilling techniques.

In the UK soft ground drilling is usually carried out by light cable percussion (shell and auger) type rigs. This method uses a simple lightweight rig developed from old well boring techniques and towable by a Land Rover type vehicle. It consists of a tripod fitted with a diesel powered winch with a clutch and brake. The winch is used to lift and drop a variety of tools down the hole in a percussive action. Hole diameters are usually 6" to 8" (150-200mm) in diameter. A clay cutter tool is used for dry cohesive soils, a shell (or baler) for granular soils and a chisel for breaking up rock or other obstructions. Casing can be installed to support caving ground or seal off groundwater.

The equivalent drilling in Queensland is carried out by mechanical auger drilling or wash boring with hole diameters generally at 75mm. Without frequent sampling it is often difficult to obtain an accurate log of the soil profile with either of these two techniques. Changes in stratum and water ingress are more easily detected in a light cable percussive bore. In addition, as larger diameter holes are drilled in the UK, larger diameter undisturbed samples are obtained. The standard undisturbed sample tube is 100mm in diameter in the UK as opposed to 50mm in Queensland. However, both augering and wash boring are faster techniques than light cable percussion boring.

4 PROCUREMENT

Perhaps the most obvious difference in site investigation practice is the manner in which site investigations are procured and in the way that geotechnical information is presented. Current UK practice is to present separate factual and interpretive reports. The factual report, which is prepared by a specialist site investigation contractor, is the only report submitted during the tender process for the main works. The interpretive report is written by the consultant to the client's specific instructions and generally only used by the design team.

The Institution of Engineers, Australia, in their 'Guidelines for the Provision of Geotechnical Information in Construction Contracts'² recognise the two approaches in the provision of geotechnical data in tender documents:

- (a) provide only incontestable fact, with no interpretation or subjectivity which could be legally challenged, and which could lead to acceptance of responsibility, and having provided this limited information disclaim any liability as to its accuracy;
- (b) allow for competent interpretation to a certain level (based on reason and a community standard of accepted engineering practice), with free acceptance by all parties that the interpretation has only a likelihood, not a certainty, of veracity. In addition, recognise the need for the fair apportionment of risk between the parties."

The recommendation given later in the guide is that "full disclosure of all known information or reports relevant to site conditions be made to tenderers on a contractual basis". As such current practice in Queensland is in line with item (b) above i.e. both the factual and interpretive information are provided in one report.

Current practice in the UK is essentially that described in (a) above. The reason for the difference of approach is probably related to the way in which the site investigation industries have evolved in the respective countries. The consultant's role in the UK is to carry out the following tasks on behalf of his client in relation to the procurement of the factual information:

- Ensure that an adequate desk study and walk-over survey is carried out;
- Define the scope of the investigation and provide the client with a cost estimate;
- Draw up the appropriate contract documents, including a specification and bill of quantities for the investigation;
- Obtain competitive tenders from at least three appropriate specialist site investigation contractors;
- Report on the tender prices to the client and make a recommendation;
- Administer the contract once it has been signed by the client and the contractor;
- Supervise the work to ensure that the technical standards are met;
- Ensure that the work is competently reported.

An advantage with the approach adopted in Australia for clients is that they only have to go to one firm for their geotechnical 'package'. In addition, the geotechnical engineers who will eventually provide the advice will have first hand experience of the ground conditions during the site investigation. This should enable them to provide a more efficient service.

5. SPECIFICATIONS

In the UK, all fieldwork and laboratory testing is carried out by specialist site investigation contractors who either have their own drillers and laboratories or subcontract to others. The consultant decides upon the scope of the investigation and on that basis draws up the specification and bill of quantities. This process was somewhat simplified in 1993 by the publication of the Site Investigation Steering Group's 'Specification for ground investigation'³ (the so called 'yellow book'). This is a specification intended for general application to site investigation work, and sets out in detail the procedures to be adopted. Schedules are provided which set out the scope of the investigation and any modifications to the specification. A bill of quantities is provided which details the items which

correspond to the investigation.

The specification not only sets out the procedures to be adopted for the drilling of boreholes and insitu testing but also for the laboratory testing of soils and rocks. The relevant British Standard is usually referred to with regard to laboratory testing. Before the 'yellow book' each consultant had its own particular specification and bill of quantities. The site investigation contractors therefore had to make themselves familiar with each particular specification prior to pricing and carrying out the work.

The need for such specifications in the UK is really a function of the procurement process whereby the specialist contractor has a contract directly with the client. Site investigation specifications are not as necessary in Queensland as most of the work is directed first hand by the geotechnical consultant. The guidance given in AS 1726 (Geotechnical site investigations)⁴ is typically used to conduct the work.

6. CONCLUSIONS

This paper has identified three main differences in site investigation practice between the UK and in Queensland:

- i. The extensive use of desk studies in the UK which is not as apparent in Queensland. Desk studies play such an important role in the UK simply because of the amount of information potentially available for the majority of the country. There are very few 'green-field' sites available for development and regeneration of derelict land is on the increase. Desk studies are therefore an extremely useful tool in not only providing a preliminary geotechnical model for the site but also its potential for contamination.
- ii. Soft ground drilling techniques are another difference. The relative merits of the light cable percussive

method used in the UK and mechanical augering and wash boring have been discussed. It is considered that the geotechnical benefits of the light cable percussive method far outweigh those of the speed of augering/wash boring. It is not hard to see how augering/wash boring is so prevalent in Queensland. The majority of drillers are self employed, and so speed and ease of drilling will be their priority.

- iii. Perhaps the greatest difference in site investigation practice is with regard to the way in which investigations are procured and how the information is reported. The method adopted in the UK is recognised by the Institution of Engineers, Australia, but not recommended. The reason for the difference of approach is probably related to the way in which the site investigation industries have evolved in the respective countries.

7. REFERENCES

1. Arup Geotechnics, "Review of Mining Instability in Great Britain", Department of the Environment, 1991.
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