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**The Value of Geotechnics in Construction
Best Practice in Site Investigation
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1. INTRODUCTION

The investigation of sites for development is the key to the whole of the geotechnical industry's work and unlocks the door to the potential benefits which result from an understanding of the behaviour of the ground and to the solutions which are available to the problems which it poses. The merits and limitations of the techniques which are used for investigation and analyses are the subject of healthy debate within the industry but the underlying benefits of good quality site investigation would be accepted by the vast majority of those attending this seminar. Many in the structural engineering and architectural professions, as well as client bodies and the public at large, may well accept the intellectual arguments that every structure or installation has to interact with the ground and hence that a knowledge of its nature and behaviour is important. However, the ways in which investigations are procured, the scale of investigation, the costs allowed for, the stage at which it is commissioned and the times allowed for this work indicate a fundamental misunderstanding of its nature, the form it takes and the contribution it can make to the construction industry and to those whom it serves. This paper will focus on the process of investigation rather than on the techniques employed, in the belief that if good practice can be encouraged and rewarded, then an improvement in the techniques will follow to the benefit of all.

2. THE NATURE OF INVESTIGATION

Site Investigation is a process which should start at project inception and continue through to beyond completion by monitoring and providing feedback to inform future design. An essential component should be the appointment of a Geotechnical Adviser. It should not be a minor item on a bar chart which is seen as starting and completing just before a job goes out to tender, which it often is. Indeed frequently such work is so inadequate that enlightened contractors involved in Design and Build tenders are increasingly commissioning their own investigations which are clearly time-constrained and cannot address all the issues. Such contractors often benefit by being able to refine proposals and thus win contracts. This also benefits the Client, as has been demonstrated on many occasions. However, this could be seen as an indictment against what should have been commissioned in the first instance, although it is recognised that certain proprietary processes may require particular investigation.

The process is essentially site-specific Research and Development (1) which should be conducted by informed professionals from the outset with an awareness of geology, geotechnics, investigation techniques, testing methods and analysis. This needs to be allied to a knowledge of performance criteria for the proposed installation and geotechnical solutions which are available. Whilst the components of a structure will have been carefully specified, the ground on which it sits cannot. Sampling and testing on a production line, for say steel components, validates satisfactory materials and processes and facilitates rejection of non-compliances. Sampling and testing of a site attempts to characterise the materials that have to be accepted as the raw material with which to work and with which the proposed structure has to interact.

The product of an investigation may be seen as data in the form of a report, the quality of which depends on those obtaining the data and the value on the abilities of those interpreting them. It is not a physical feature to which most Civil Engineering contracts relate. Hence the concepts and means of procurement need to take this into account.

3. THE PROCUREMENT OF INVESTIGATION

3.1 Current Practice

In order to gain an appreciation of what might be a desirable objective it is necessary to consider what happens at present. Whilst there are many enlightened clients and advisers who follow approaches developed by the industry (2), investigations are often designed by those with only a rudimentary knowledge of what they may consist of. As a practitioner in this industry we regularly get faxed letters or hand-written notes asking for a competitive quotation for "x" boreholes to "y" metres, perhaps with some trial pits and some allowance for

testing, and requiring a "comprehensive" report, without any indication of proposed layouts, levels or loadings. The other form of enquiry is a request for a comprehensive investigation, without definition of its form or scale, only the site's location. Minimal investigation will clearly give a low price. "When can you be on site?" is the most frequently asked question and the concept of desk studies and site reconnaissance prior to the investigation is regarded with suspicion. The firm with the cheapest quotation almost invariably gets such work.

The problems with the current procurement practice may be summarised as:

- Inadequate preparation
- Inadequate funds
- Inadequate time
- Inadequate phasing

leading to:

- Inadequate product

It is the client who suffers for this approach even though he may be told that he has saved some money. The greatest cost is the completed structure or other development and savings on the site investigation are likely to be submerged by the cost of inefficient designs, if they are safe, or by taking high risks, either during construction or in relation to final performance, if they are not.

The costs of site investigation are dominated by fieldwork and if the award is made on the lowest price then it goes to the company who can drill a hole and fill it in again most cheaply, those who propose less investigation or, perhaps worse still, to those who log samples, do laboratory tests and provide an interpretation most cheaply. Whilst it is recognised that site and office management, methods of gaining access to sites and novel techniques can impinge upon prices, the environment which this approach creates is not conducive to the quality which should be encouraged.

Costs published by Thomas Telford (3) indicate that the average cost of site investigations is some 0.21% of total project costs. If competitive tenders are awarded on a differential of say 10% between the winning tender and the second-placed price then this amounts to 0.021% of project cost, equivalent to £2,100 on a £10m contract. This calls into question the justification for this process, bearing in mind the procurement costs and associated time taken.

3.2 Future Developments

The Treasury in its Procurement Policy Guidelines is now emphasising that "All public procurement of goods and services, including works, is to be based on value for money, having due regard to propriety and regularity" (4). Value for money is defined as "..... the optimum combination of whole-life cost and quality (or fitness for purpose) to meet the users requirements". Value may also be defined as Function divided by Cost.

Perhaps then, Government may be the instrument of change of hearts and minds; we shall see. What is required is a definition of what constitutes "Good Practice" so that it can be made known to those who have a need for good quality, adequate and good practice and cost-effective investigation.

3.3 Good Practice

The issue of good practice has been addressed by the Association of Geotechnical and Geoenvironmental Specialists (AGS) in two publications. "AGS Guidelines for Good Practice in Site Investigation" is intended for those who commission or procure investigations and "AGS Code of Conduct for Site Investigation" for practitioners. Both were developed by those within the industry representing Consultants and Ground Investigation Specialists and can reasonably be regarded as representative of the industry. Indeed it is a requirement of membership of the AGS that they are signed up to, thus encouraging high standards and providing a benchmark of performance for its clients. Each is published on two sides of a single sheet and these are being made readily available; copies accompany this paper. They are also available on the AGS web site (www.ags.org.uk). The Guidelines cover: -

- Risk and Value
- Management
- Desk Study
- Ground Investigation
- Training
- Responsibility
- Feedback
- Continuing Improvement
- References
- Training Paths for Geoprofessionals

The Code of Conduct covers the conduct of: -

- AGS
- All practitioners

- Ground Investigations (G.I.) Specialists.
- Consultants (including G.I. Specialists acting as Consultant)
- Main Contractors/Specialist Sub-Contractors.

Both documents are couched in terms of encouragement rather than in the form of strict rules.

The hope is that those who follow these guidelines from all sides will prosper at the expense of those who do not and that the reputation of the industry and its benefits will continue to rise.

4. OTHER INFLUENCES

Changes are beginning to occur in the Site Investigation industry as a result of other influences. Concern for the contamination of sites and the encouragement to develop "Brownfield Sites" has led both to legislation and the need for bodies such as the NHBC, Investors and Insurers to be re-assured that this issue is properly addressed by investigation and adequate remediation where appropriate. The need to identify current conditions on site, such that it can be demonstrated at a later date that the use to which it is put has not caused pollution, is a requirement of IPPC regulations. We would all consider that an adequate geological and groundwater profile was a key to identifying the risk through the contaminant-pathway-receptor model. Such profiles, with associated physical characterisation, would also allow the benefits of geotechnical engineering to be realised.

A document on guidance for Combined Geotechnical and Geoenvironmental Investigation is currently in preparation by the AGS with an anticipated date for publication in June.

Concepts of Risk Management are beginning to be promoted both in relation to geotechnical and geoenvironmental matters. As a risk management tool Site Investigation is extremely valuable even though we would also claim that it is not just in reducing risk but also in optimising design solutions where its value lies. The industry must make its point strongly in the knowledge that it is backed by the whole geotechnical community.

REFERENCES

- 1) Threadgold L., "*Site Investigation within the development process*". Midland Geotechnical Society, ICE, AGS, June 1997.
- 2) "*Planning, procurement and quality management*", Site Investigation Steering Group, Thomas Telford 1993.
- 3) "*Inadequate Site Investigation*". The Institution of Civil Engineers, Thomas Telford 1991.
- 4) H.M. Treasury Procurement Policy Guidelines, Procurement Policy Unit, November 1998 - www.hm-treasury.gov.uk

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