Geo-Impuls

“International Co-operation”

Report reconnaissance mission to the United Kingdom, May 2012

Working Group 11

March 18, 2013

Paul Cools, Rijkswaterstaat

Contents

1. Summary

Introduction

On January 1st, 2010 the Geo-Impuls program has started. The goal of this program is to reduce geotechnical failure in projects by half in 2015. One of the twelve Working Groups is involved with "International Co-operation" (Working Group 11).

The project plan of this Working Group aims at the exchange of knowledge between countries with similar geotechnical problems as the Netherlands. The United Kingdom is one of these countries.

From May 14 to 16, 2012 four members of WG 11 have visited the UK. These members are:

- Joost van der Schrier, Royal Haskoning DHV (Chairman WG 11)
- Paul Cools, Rijkswaterstaat, Ministry of Infrastructure and Environment (Secretary Steering Committee Geo-Impuls)
- Dr. Peter van den Berg, Deltares
- Onno Hazelaar, ProRail

Itinerary

The following experts have been interviewed:

- University of Cambridge
    - Prof. Robert Mair

- Arup
    - Brian Simpson (Director Ove Arup & Partners Ltd)
    - Duncan Nicholson (Director)
    - Tim Chapman (Director)
    - Bill Grose (Director)

- Institute of Civil Engineers (ICE)
    - Prof. Barry Clark; Senior Vice President ICE, Professor of Civil Engineering Geotechnics University of Leeds
    - Paul Maliphant; Halcrow Group Limited, Director of local authority partnerships
    - Prof. Chris Clayton: Geotechnical Engineer, Professor of infrastructure engineering at Southampton
    - Brendan van Rooijen; ICE, Dispute Resolution Services Manager

- Highways Agency
    - David Patterson, Geotechnical Advisor, Bristol
    - Andrew Jukes, Technical Assurance Group (Geotechnics), Birmingham
    - Alex Kidd, Bedford

- NetworkRail:
    - Tony Wilcock, Head of Civils Asset Management (Geotechnical), Manchester
    - Mr. Evans

Agenda

Before starting the discussion, Paul Cools presented the headlines of the Geo-Impuls programme. The agenda was not fixed and the discussion developed more or less spontaneous during and after the presentation. Many aspects have been discussed in relation to geotechnical risk management, as listed below:

- geotechnical failure
- causes for geotechnical failures
- importance of geo-engineering
- contracts
- geo-engineering
- knowledge exchange
- Observational Method
- Registered Engineers
- Standards
- Risk based assetmanagement
- Geo-Impuls Program

Geotechnical failure

Failure can have many different meanings. It could be catastrophic (full collapse) but also (minor) disfunctioning, resulting in additional costs but also leading to, for instance, loss of reputation. In this respect, Geo-Impuls uses a wide definition.

Geotechnical risk management

In the UK, every big project, like the Cross Rail project, has a special risk management program. There is a panel of five experienced persons, continuously monitoring and ranking the different risks, resulting into an actual risk ranking system. In relation to the most important risks, risk workshops are organized per aspect in order to quantify the risk and to define possible mitigation measures. On-line monitoring is very important. A "traffic light" system is being used to highlight the most

important attention areas. Scenarios are being developed continuously to minimize and to manage the most important risks.

It is of utmost importance for risk management that the whole system (whole chain from desk to site in all phases) has to work smoothly. For instance in the Cross Rail project all parties are present every day to check and to discuss the monitoring data. In addition it is also important that there is a clear line of action at the moment a problem is coming up.

There was a discussion on RisMAN and GeoQ (which were introduced as tools from the Geo-Impuls toolbox). The work of Deltares/Martin van Staveren with respect to GeoQ was known, published in English. RISMAN was not known and it was asked whether this method was also published in English. But, the overall opinion was that these methods were examples of ways to do proper risk management. As such they were not recognized as new or innovative. In the London Tunnelling project, for example, in which Arup is involved, risk management is treated as a key-issue (risk sessions were frequently organized with different disciplines attending). Risk management is fully implemented in the London Tunnelling project over its full project chain.

"Managing Geotechnical Risk", a book from Chris Clayton (2001) is broadly seen as an important book. The essential principles for in his view are:

- Ground is a common cause of significant delay and cost increase in construction
- Need for systematic risk management started early with
  - Desk study and walk-over survey
  - Expert identification of geotechnical hazards and risks, and
  - Communication
- Implications of conditions of contract for risk sharing and methods of dealing with unforeseen ground conditions
- The importance of design in minimizing risk

Causes for geotechnical failures

Although geotechnical failures in most cases do have more than one cause, one underlines that in many cases ground investigation is inappropriate.

In the UK geotechnical problems are mostly related to unforeseen heterogeneity of the subsoil, including unforeseen stones and boulders. In the UK there is not so much very soft clay and peat. Due to the glacial geology, overconsolidated stiff clays are present at many places.

It was pointed out that the execution phase was often found to be critical in terms of risk. Other identified risk items were:

i) Insufficient monitoring during execution
ii) Knowledge transfer from design phase to the execution phase
iii) Pressure from a commercial point of view, the pressure to construct the project on time against low costs.
iv) Involvement of the environment, the public were considered important and it was considered that public should be involved from an early stage in the project. Through dialogue at the planning phase, but also during the execution of the works: 'Community participation' was here the key-word.

Structural collapse was not recognized as a dominant issue. Good engineering practice would be able to avoid this. It's a (just) a question of doing what should be done. A trend was noted to go for the cheapest price, which would not be beneficial in terms of project quality.

ICE explains the importance of teamwork and the role of a good geotechnical engineer by reducing risks. The experience is that by a lot of important decisions made by the Welsh Government no geotechnical engineer is involved. That is a big mistake because the importance of geotechnics in handling project costs and reducing project risks is major. His focus is on teamwork and importance and role of geotechnical engineers in project teams.

Importance of geo-engineering

Although one is not aware of exact figures with respect to the percentage of geotechnically related failure costs, compared to the overall failure costs, one underlines that in most cases claims of contractors are highly related to unforeseen problems, related to building activities inside the subsoil.

Research carried out in 2012 revealed that the costs for building infrastructure in the UK was significantly higher compared to elsewhere in Europe. The reason for this is currently subject for some debate and research in the UK. Geotechnical failure however was not identified as an issue. Providing good engineering consultancy requires good educated staff (do not fire to quickly and take care of proper recruitment) and clear leadership.

Contracts

GBR's (geotechnical baseline reports) are widely used in projects. In contrasts to earlier days, now risk allocation is used in contracts, for

instance with respect to the occurrence of stones in the subsoil. In addition to the GBR, you also have the GIR (geotechnical interpretation report). In some cases at the moment they want to merge both reports into a GBIR (geotechnical baseline and interpretation report). Mair is not very enthusiastic about this combined report; separation of base information and interpretation is important.

ICE gave us a short explication of the working of Dispute Resolution in the building society. This is a new way of adjudication used by engineering contracts. Within 28 days there must by a solution otherwise there is directly the step to Court. It is a cheaper and much quicker way of dealing with disputes within the civil engineering. Also because the costs it makes it easier for smaller companies to claim.

Barry Clark explained the importance of knowing the drivers which leads to risks but also leads to acknowledge that actions are needed to do something about it. Of course there are the costs but also the increasing number of claims. Rather new is the low carbon economy. A rather new development is the introduction of BIM (Building Information management). This is obliged starting by 2019 for all building projects. BIM plays a big role by dividing and sharing the risks.

Geo-engineering: monitoring

In UK a big research program is executed with respect to innovation and application of the newest sensor technology to infrastructural projects, especially for the period after completion of the project. (18 million pound); Konichi Soga (University of Cambridge) is highly involved in this program.

Knowledge exchange

Professor Mair underlines that (international) exchange of experience is very valuable. For instance the problems with loose fine-grained sands in the Netherlands (the North-South metro line) had consequences for the same type of project in Singapore; jet-grouting of joints is being used there in order to prevent the same type of problem as in Amsterdam.

Observational Method

Monitoring is important, but it is much more important "what is being done with monitoring data", what is the procedure, what is the line of action at the moment measured data start to deviate from the expected values. For instance, post-analyzing the measured data, related to the big Heathrow accident, indicated that in fact failure started three months (!) before the big catastrophe took place.

Registered Engineers

The ICE has started to register the civil engineers. This means that above the scope of a charted engineer also the experiences, skills and competences of civil engineers are known. This is a big step forward to create a higher level of quality to the Geotechnics and reducing the risks.

Standards

Highways Agency manages their geotechnical risks by using the "The Design Manual for Roads and Bridges", which consists of 25 volumes, specifically Standard HD 22/08: "Managing Geotechnical Risk". This standard is Part 2 of Volume 4, Geotechnics and Drainage, section 1, Earthworks.

This standard sets out the procedures to be followed and certificates to be used during the process of planning and reporting of all Geotechnical Works carried out on highways under the jurisdiction of the relevant Overseeing Organisation to ensure that the Geotechnical Risk is correctly managed.

To be effective in terms of reducing risk and identifying opportunities, geotechnical risk management should be started as soon as possible following project identification. Appendix A of Standard HD 41 (Ref 5) provides advice on what constitutes geo-hazards that pose risks and will need to be considered when developing the risk registers for a project. The establishment of the Geotechnical Risk Register is an essential part of these procedures and is developed and refined as the project progresses.

Geotechnical risk management should not be carried out in isolation, but should be considered as an integral part of the whole of the project process from initial planning through to construction and completion. The processes set out in this Standard will require interaction between all members of the project team.

To ensure that the geotechnical risks are identified and then correctly managed this Standard requires the project team to follow a logical sequence of reporting and review of the geotechnical design process. The Standard sets out Key Stages to be followed during the process of planning and reporting Geotechnical Activities for all highways under the jurisdiction of the relevant Overseeing Organisation. These Key Stages link in with the major parts of the overall project procurement process.

Risk based assetmanagement

Regarding geotechnical assets Highways Agency refers to another Standard of the "The Design Manual for Roads and Bridges", Standard HD 41/03: "Maintenance of Highway Geotechnical Assets". This Standard is Part 3 of Volume 4, Geotechnics and Drainage, section 1, Earthworks.

This Standard deals with:
- The Inspection of Geotechnical Assets
- Risk Assessment of Geotechnical Features
- Certification Procedures for Remedial Works and Preventative Measures

Regarding risk assessment of geotechnical features the methodology is summarized as:
What + Where + When => Risk Level => Action

The management of the assets regarding maintenance and renewals is a Risk Based Approach. It is finding the right balance between the service level, the risk level and the cost (defined budget).

Geo-Impuls Programme

It was mentioned that the primary responsibility of managing risks lies by the profession itself. The society is the product of its own civilians. It was considered important to account for the fact that different stakeholders exist. Government, public and industry contribute in different ways and it should carefully be considered where to put the main efforts.

The fact that the central government (in the form of Rijkswaterstaat) took its responsibility and started the initiative to start Geo-Impuls and bring different stakeholders together was considered a major step forwards. Geotechnical expertise in UK is organized in Agencies rather than in one central governmental body (which would make the setting-up of a Geo-Impuls like program slightly more complicated).

2. Minutes of University of Cambridge

Monday 14th of May 2012 at University of Cambridge

Reporter: Peter van den Berg (Deltares)

Present from University of Cambridge:

- Prof. Robert Mair

Robert Mair was appointed Professor of Geotechnical Engineering at Cambridge University in 1998. He is Head of Civil and Environmental Engineering. He is also one of the founding Directors of the Geotechnical Consulting Group (GCG), an international consulting company based in London, started in 1983. After graduating in 1971 from Cambridge University, he worked continuously in industry until 1998, except for a three year period in the late 1970's when he returned to Cambridge to work for his PhD on tunneling in soft ground. His early involvement with tunnels began at that time, when he undertook research for the UK Transport Research Laboratory on the subject of centrifuge modeling of tunnel construction in soft ground.

Throughout his career he has specialised principally in underground construction, providing advice on numerous projects world-wide involving soft ground tunneling, retaining structures, deep excavations and foundations. Recent international projects have included railway tunnels in the cities of Amsterdam, Barcelona, Bologna, Florence, Rome and Warsaw, and motorway tunnels in Turkey. In the UK he has been closely involved with the design and construction of the Jubilee Line Extension for London Underground, and with the Channel Tunnel Rail Link and CrossRail projects. He was responsible for the introduction of compensation grouting in the UK as a novel technique for controlling settlement of structures during tunnel construction - on the Waterloo Escalator Tunnel Project. The technique was widely used on the Jubilee Line Extension Project for the protection of many historic buildings, including the Big Ben Clock Tower at the Palace of Westminster.
He has been a member of Expert Review Panels on major international underground construction projects, and is currently Co-Chair of the International Advisory Board for the Singapore Land Transport Authority, advising on design and construction aspects of all underground transport tunnels and deep excavations in Singapore. He was a member of the French Government Commission of Enquiry into the collapse of a road tunnel in Toulon.

Geotechnical risk management

Before starting the discussion, Paul Cools presented the headlines of the Geo-Impuls programme. During and after the presentation many aspects have been discussed in relation to geotechnical risk management, listed below.

Definition of "failure". Failure can have many different meanings. It could be catastrophic (full collapse) but also (minor) disfunctioning, resulting in additional costs but also leading to, for instance, loss of reputation. In this respect, Geo-Impuls uses a wide definition.

Mair explains how geotechnical risk management is organized in big projects in the UK, especially focused on the CrossRail project. There is a special risk management program; there is a panel of five experienced persons, continuously monitoring and ranking the different risks, resulting into an actual risk ranking system. In relation to the most important risks, risk workshops are organized per aspect in order to quantify the risk and to define possible mitigation measures. On-line monitoring is very important. A "traffic light" system is being used to highlight the most important attention areas. Scenarios are being developed continuously to minimize and to manage the most important risks.

Although geotechnical failures in most cases do have more than one cause, he underlines that in many cases ground investigation is inappropriate. He refers to the work of Chris Clayton, who worked out a structured approach for the amount and the type of ground investigation in different phases of the project, in relation to risk management.

In the UK geotechnical problems are mostly related to unforeseen heterogeneity of the subsoil, including unforeseen stones and boulders. In the UK there is not so much very soft clay and peat. Due to the glacial geology, overconsolidated stiff clays are present at many places.

Although he is not aware of exact figures with respect to the percentage of geotechnically related failure costs, compared to the overall failure costs, he underlines that in most cases claims of contractors are highly related to unforeseen problems, related to building activities inside the subsoil.

GBR's (geotechnical baseline reports) are widely used in projects. In contrasts to earlier days, now risk allocation is used in contracts. For instance with respect to the occurrence of stones in the subsoil. In addition to the GBR, you also have the GIR (geotechnical interpretation

report). In some cases at the moment they want to merge both reports into a GBIR (geotechnical baseline and interpretation report). Mair is not very enthusiastic about this combined report; separation of base information and interpretation is important.

It is of utmost importance for risk management that the whole system (whole chain from desk to site in all phases) has to work smoothly. For instance in the CrossRail project all parties are present every day to check and to discuss the monitoring data. In addition it is also important that there is a clear line of action at the moment a problem is coming up.

In UK a big research program is executed with respect to innovation and application of the newest sensor technology to infrastructural projects, especially for the period after completion of the project. (18 million pound); Konichi Soga (University of Cambridge) is highly involved in this program.

Learning from bad experience. Mair underlines that (international) exchange of experience is very valuable. For instance the problems with loose fine-grained sands in the Netherlands (the North-South metroline) had consequences for the same type of project in Singapore; jet-grouting of joints is being used there in order to prevent the same type of problem as in Amsterdam.

Monitoring is important, but it is much more important "what is being done with monitoring data", what is the procedure, what is the line of action at the moment measured data start to deviate from the expected values. For instance, post-analyzing the measured data, related to the big Heathrow accident, indicated that in fact failure started three months (!) before the big catastrophe took place.

Some miscellaneous remarks:

- There was a lot of mutual recognition between developments in the Netherlands and in the UK
- In-situ ground investigation in combination with on-line monitoring is very important
- Design of piled foundations in the UK seems to be (very) conservative due to hidden safety aspects
- A kind of partnering between contractor and client is important; in the UK they speak about ECI (early contractor involvement) and OCI (optimal contractor involvement)

Since they recently had several accidents, mostly landslides (including lost of life), in Hongkong they established the GCO (geotechnical control office), which has to give a final approval to a project.

3. Minutes of ARUP

London: Tuesday 15th of May 2012 (Fitzroy Street Office)

Reporter: Joost van der Schrier (Royal Haskoning DHV)

Present from ARUP

- Brian Simpson (Director Ove Arup & Partners Ltd)
- Duncan Nicholson (Director)
- Tim Chapman (Director)
- Bill Grose (Director)
- 15 other Arup Employee attending the Geo-Impuls lunch presentation.

Paul Cools took presented the Geo-Impuls program using power-point. His presentation was embedded in an interactive video-session, which was broadcasted for information and feedback over the different overseas Arup offices.

The presentation was well received. The importance and need for risk management was fully supported. It was noted that discussions on this matter were not new and reference was made to the work of Chris Clayton and others from some 10 years ago.
It was pointed out that the execution phase was often found to be critical in terms of risk. Other identified risk items were:

v) Insufficient monitoring during execution
vi) Knowledge transfer from design phase to the execution phase
vii) Pressure from a commercial point of view, the pressure to construct the project on time against low costs.
viii) Involvement of the environment, the public were considered important and it was considered that public should be involved from an early stage in the project. Through dialogue at the planning phase, but also during the execution of the works: 'Community participation' was here the key-word.

Structural collapse was not recognized as a dominant issue. Good engineering practice would be able to avoid this. It's a (just) a question of doing what should be done. A trend was noted to go for the

cheapest price, which would not be beneficial in terms of project quality.
Research carried out in 2012 revealed that the costs for building infrastructure in the UK was significantly higher compared to elsewhere in Europe. The reason for this is currently subject for some debate and research in the UK. Geotechnical failure however was not identified as an issue. Providing good engineering consultancy requires good educated staff (do not fire to quickly and take care of proper recruitment) and clear leadership.

It was mentioned that the primary responsibility should come from the profession itself. The society is the product of its own civilians. It was considered important to account for the fact that different stakeholders exist. Government, public and industry contribute in different ways and it should carefully be considered where to put the main efforts. The fact that the central government (in the form of Rijkswaterstaat) took its responsibility and started the initiative to start Geo-Impuls and bring different stakeholders together was considered a major step forwards. Geotechnical expertise in UK is organized in Agencies rather than in one central governmental body (which would make the setting-up of a Geo-Impuls like program slightly more complicated).

Another important issue raised during the discussions was that the loss ratio in tunnelling was far too high in 2010 (due to construction claims). As a result it became very difficult to insure tunnel projects.To solve this problem a joint code of practice for risk management and construction works resulted, with focus on tunnel construction.

There was a discussion on RisMAN and GeoQ (which were introduced as tools from the Geo-Impuls toolbox). The work of Deltares/Martin van Staveren with respect to GeoQ was known, published in English. RISMAN was not known and it was asked whether this method was also published in English. But, the overall opinion was that these methods were examples of ways to do proper risk management. As such they were not recognized as new or innovative. In the London Tunnelling project, for example, in which Arup is involved, risk management is treated as a key-issue (risk sessions were frequently organized with different disciplines attending). Risk management is fully implemented in the London Tunnelling project over its full project chain.

Other issues that were considered important for the future (from a risk management & control perspective) are:

- Building Information Systems (of importance, information management and transfer is a key-factor).
- Knowledge sharing and transfer.

- IT data strategy (as IT will, for several reasons, become more and more important).
- Methods to spot problems before they become serious.
- Long term monitoring (the monitoring research program initiated recently by Cambridge University was mentioned). It was also recognized that funding of such long term monitoring might be very difficult.
- Partnering(on time and budget)
- Learning from the past, where it was noted that the International Conference on Forensic Engineering contained could useful material in this respect.

Remarks

Arup did not recognize geotechnical failure (structural failure) as an issue. Proper consultancy and risk management (with already available tools) would eliminate the majority of the problems. Arup expressed the attitude of a company that considers itself as one of the frontrunners in the field of geo risk management. In the broadest sense, with emphasize on reducing cost-overrun and time-delays and community participation. The Geo-Impuls programme was however considered of importance and Arup was very interested to hear from the results in the coming future.

4. Minutes of ICE

London: 16th of May 2012

Reporter: Onno Hazelaar (ProRail)

Present

- Barry Clark; ICE Senior Vice President, Professor of Civil Engineering Geotechnics University of Leeds
- Paul Maliphant; Halcrow Group Limited, Director of local authority partnerships
- Chris Clayton: Geotechnical Engineer, Professor of infrastructure engineering at Southampton
- Brendan van Rooijen; ICE, Dispute Resolution Services Manager

We had a very warm welcome by Brendan van Rooijen, Dispute Resolution Services Manger by ICE.

Spoken subjects:

- Dispute Resolution
- ICE booklet "Handling Uncertainty"
- Managing Geotechnical Risks
- Registered Engineers
- BIM

Brendan van Rooijen gave us a short explication of the working of Dispute Resolution in the building society. This is a new way of adjudication used by engineering contracts. Within 28 days there must by a solution otherwise there is directly the step to Court. It is a cheaper and much quicker way of dealing with disputes within the civil engineering. Also because the costs it makes it easier for smaller companies to claim.

The ICE has sponsor a booklet over handling uncertainty. A overview of Enterprise Risk Management for civil engineering which gives a approach managing uncertainties. Basics are:

- Thinking of a business as a system
- Focusing on situations rather than just events
- Use new techniques
- Important role for a Business Risk Leader.

A lot of Risk issues are viewed and combined with recommended Best practices.
We all collected a booklet by the title "Handling uncertainty- the key to truly effective Risk Management".

Chris Clayton told about his book "Managing Geotechnical Risk" from 2001. This book is broadly seen as an important book. The essential principles for in his view are:

- Ground a common cause of significant delay and cost increase in construction
- Need for systematic risk management started early with
  - Desk study and walk-over survey
  - Expert identification of geotechnical hazards and risks, and
  - Communication
- Implications of conditions of contract for risk sharing and methods of dealing with unforeseen ground conditions
- The importance of design in minimizing risk

There is a very big overlap with the Geo-Impuls program.

A big disappointment is however that this book is well recommended but as shown over the past years there is made no major progress.

Paul Maliphant explained the importance of teamwork and the role of a good geotechnical engineer by reducing risks. His experience is that by a lot of important decisions made by the Welsh Government no geotechnical engineer is involved. That is a big mistake because the importance of geotechnics in handling project costs and reducing project risks is major.
His focus is on teamwork and importance and role of geotechnical engineers in project teams.

Another statement is that de safety factor for geotechnical risks is 3 and for other techniques this is commonly 1.7. Here for the general opinion is that geotechnics is too expensive and the risks are minimal.

Next to reducing the geotechnical risks there is the importance of Carbon/CO2-reduction. The challenge is to manage both issues. Again this asks a lot of the geotechnical engineer, his skills and competence. The statement 'never waste a good crisis 'also works here to focus on better actions to improve the work of geotechnical engineers.

The ICE has started to register the civil engineers. This means that above the scope of a charted engineer also the experiences, skills and competences of civil engineers are known. This is a big step forward to create a higher level of quality to the Geotechnics and reducing the risks.

Barry Clark explained the importance of knowing the drivers which leads to risks but also leads to acknowledge that actions are needed to do something about it. Of course there are the costs but also the increasing number of claims. Rather new is the low carbon economy. A rather new development is the introduction of BIM (Building Information management). This is obliged starting by 2019 for all building projects. BIM plays a big role by dividing and sharing the risks.

Remarks

The discussion was not very organized. Paul and Chris were late because they were unaware of our presents. Barry was (as told) one hour later. I think compared with the other visits this was more of an open discussion of the world of geotechnics in Great Britain and the needs to improve the quality of geotechnical works by working with registered engineers and a more structural way of working.
My opinion is that they relay a lot on actions already taken within the building society. Their own efforts for research and Development and for improvement of the sector are minor. We gave them some new approaches witch they can use to create a broader sense of urgency to do more about geotechnical risks.

5. Minutes of Highways Agency

Wednesday 16th of May 2012 at Highways Agency (HA), London

Reporter: Paul Cools (Rijkswaterstaat)

Present from Highways Agency:

- David Patterson, Geotechnical Advisor, Bristol
- Andrew Jukes, Technical Assurance Group (Geotechnics), Birmingham
- Alex Kidd, Bedford

Present from NetworkRail:

- Tony Wilcock, Head of Civils Asset Management (Geotechnical), Manchester
- Evans?

Presentation Alex Kidd: "Geo Risk Management"

In his presentation Alex Kidd explains the way HA manages their geotechnical risks. HA uses the "The Design Manual for Roads and Bridges", which consists of 25 volumes. Alex refers to Standard HD 22/08: "Managing Geotechnical Risk". This standard is Part 2 of Volume 4, Geotechnics and Drainage, section 1, Earthworks.

This standard sets out the procedures to be followed and certificates to be used during the process of planning and reporting of all Geotechnical Works carried out on highways under the jurisdiction of the relevant Overseeing Organisation to ensure that the Geotechnical Risk is correctly managed.

To be effective in terms of reducing risk and identifying opportunities, geotechnical risk management should be started as soon as possible following project identification. Appendix A of Standard HD 41 (Ref 5) provides advice on what constitutes geo-hazards that pose risks and will need to be considered when developing the risk registers for a project. The establishment of the Geotechnical Risk Register is an essential part of these procedures and is developed and refined as the project progresses.

Geotechnical risk management should not be carried out in isolation, but should be considered as an integral part of the whole of the project process from initial planning through to construction and completion. The processes set out in this Standard will require interaction between all members of the project team.

To ensure that the geotechnical risks are identified and then correctly managed this Standard requires the project team to follow a logical sequence of reporting and review of the geotechnical design process. The Standard sets out Key Stages to be followed during the process of planning and reporting Geotechnical Activities for all highways under the jurisdiction of the relevant Overseeing Organisation. These Key Stages link in with the major parts of the overall project procurement process.

There are four Key Stages in the Geotechnical certification procedure. These stages are arranged to be an integral part of the overall project progression to ensure the procurement of the geotechnical information necessary to undertake an accurate assessment of project risks. They are listed below:

Key Stage 1 Initial Review of Project and Geotechnical Risks to determine its Geotechnical Classification and thus the requirement for Geotechnical Certification: *This stage ensures that potential geotechnical risks are identified at project inception. The requirements for specialist geotechnical processes are also assessed at this stage. The document required from the Designer at this stage is the Statement of Intent.*

Three categories are used to classify geotechnical risks (also used in EC7), which depend on level of risk, not on the size of the project:

- Category 1: simple geotechnical activities and small geotechnical risk
- Category 2: conventional types of geotechnical activities, nothing unusual or abnormal
- Category 3: very large, unusual or complex geotechnical activities or activities involving abnormal geotechnical risks or unusual or exceptionally difficult ground conditions

Key Stage 2 Preliminary Assessment including Preliminary Certification: *This stage contributes to the preparation of the outline design and where necessary the requirement for land acquisition and orders preparation. The documents required from the Designer at this*

stage are the Preliminary Sources Study Report (Desk Study) and the Ground Investigation Report.

Key Stage 3 Geotechnical Design and Construction Certification: *This stage provides the information for the detailed design and for the contractor to prepare and carry out construction. The output required from the Designer at this stage is a Geotechnical Design Report with all sections completed prior to construction of relevant areas.*

Key Stage 4 Geotechnical Feedback: *This stage reports on all construction work and particularly any unexpected ground conditions requiring changes to design that occurred. This Key Stage is a requirement in contracts let by the Overseeing Organisation. The output required from the Designer at this stage is the Geotechnical Feedback report.*

The Statement of Intent, Preliminary Sources Study Report (Desk Study), the Ground Investigation Report, the Geotechnical Design Report and the Feedback Report comprise the main requirements for this Standard. These reports are supported by a single certificate system included in Appendix A. The first chapter of this appendix is illustrated below:

HAGDMS No…..

GEOTECHNICAL CERTIFICATE

Form of Certificate to be used by the Designer for certifying the design of geotechnical works

1. We certify that the Reports*, Design Data*, Drawings* or Documents* for the Geotechnical Activities listed below have been prepared by us with reasonable professional skill, care and diligence, and that in our opinion:

i. constitute an adequate and economic design for the project

ii. solutions to all the reasonably foreseeable geotechnical risks have been incorporated

iii. the work intended is accurately represented and conforms to the Employer's*/Client's* requirements

iv. with the exception of any item listed below or appended overleaf, the documentation has been prepared in accordance with the relevant standards from the Design Manual for Roads and Bridges and the Manual of Contract Documents for Highway Works.

where the certificate is accompanying revision to design data already certified the following statement shall also be included

v. *The design elements covered by this certificate are not detrimental to the design elements previously certified and not amended by this certificate*

2. LIST OF REPORTS, DESIGN DATA, DRAWINGS OR DOCUMENTS

Alex Kidd mentions three reasons why certification is needed:

- To ensure that all parties are aware of these risks, they must be documented and shared with the Overseeing Organisation.
- The formal process that records this is "Geotechnical Certification"

- Each report is accompanied by a Geotechnical Certificate

Presentation David Patterson: "Assetmanagement"

David starts his presentation with the management of geotechnical assets and further on shows the development of a common approach for all asset types.

Regarding geotechnical assets he refers to another Standard of the "The Design Manual for Roads and Bridges", Standard HD 41/03: "Maintenance of Highway Geotechnical Assets". This Standard is Part 3 of Volume 4, Geotechnics and Drainage, section 1, Earthworks.

This Standard deals with:
- The Inspection of Geotechnical Assets
- Risk Assessment of Geotechnical Features
- Certification Procedures for Remedial Works and Preventative Measures

Regarding risk assessment of geotechnical features the methodology is summarized as:
What + Where + When => Risk Level => Action

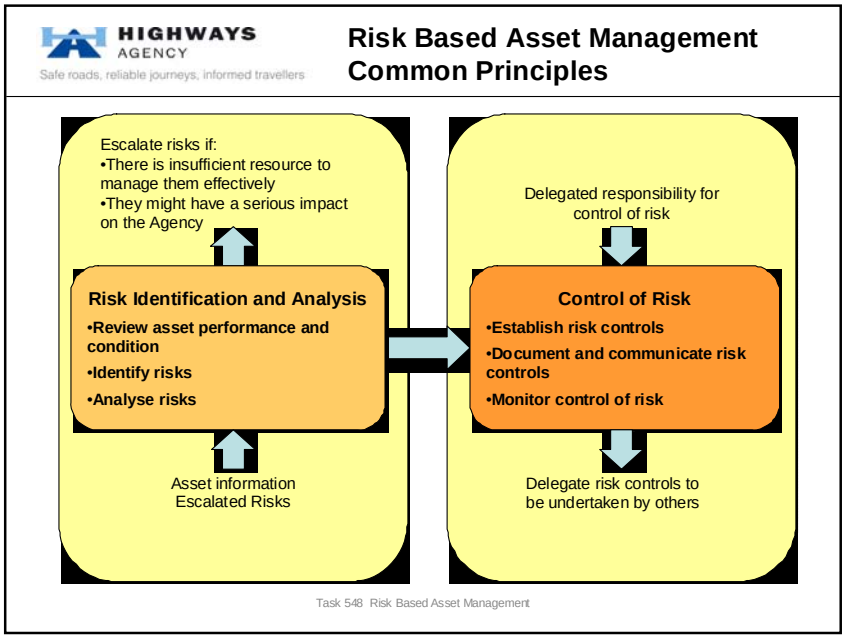
The components of the assessment are:
- Class (What) - A classification of each feature:

Class 1: Areas of defect.
Class 2: Areas at risk.
Class 3: Areas of repair, strengthening and preventative works.
- Location Index (Where) - Giving the location of the feature in relation to the highway or other asset of importance.
- Timeframe (When) - The period that the assessment applies to.
- Risk matrix by timeframe (Risk Level) – An assessment of risk level based on the previous three inputs.
- Actions Table (Action) - Indicating the action required and when.

The certification procedures to be followed for the design and implementation of remedial works and preventative measures depend on the Class of geotechnical failure:
- Class 1: Areas of defect: Geotechnical Certificate required
- Class 2: Areas at risk: Geotechnical Certificate required
- Class 3: Areas of repair, strengthening and preventative works: Geotechnical Certification procedures not applicable

David now shows the development of a common approach for áll asset types. The management of the assets regarding maintenance and renewals is a Risk Based Approach. It is finding the right balance

between the service level, the risk level and the cost (defined budget). The common principles of this approach are:



Remarks

- The presentations of HA took a bit longer than expected, which did not leave a lot of room for discussion.
- HA also sees a development to more "outcome-based" contracts like DBFM and more early involvement in D&B contracts (partnering).
- HA has an interest in the results of our fact finding mission to the USA.
- The geotechnical costs of a project are approx. 1/3 of the total costs, including claims for unforeseen ground conditions.
- HA supports the ICE initiative on reducing geotechnical risks.
- There is a great need for correct asset management data (e.g. unit costs). Maintaining the knowledge base is another problem in view of reorganizations and early retirements. Knowledge exchange between organizations and countries would be helpful. Joost van der Schrier feels reluctance from companies to provide their performance figures in view of competition.
- NetworkRail has a lot of information on assets over a period of more than 170 years.
- David states that the conditions of most of the geotechnical constructions are not clear at this moment.
- HA and NetworkRail strongly believe in combining geotechnics with other disciplines and working in project teams.

- About 100 Geotechnical Certificate are signed yearly. This Certificate will be signed by the Designer and than by the Client. This does not mean that the Client will be responsible. The main advantage of the certificate is that a geo-engineer was involved with the project.
- Joost feels that a certificate is just one piece of Geo Risk Management. Other aspects like planning, construction and asset management are important.
- The Risk Register ensures that all geotechnical risks are allocated to either Contractor or Client.
- David mentions the Road Renewal Programme, which consists of some 200 projects with a total yearly budget of 500 million pounds.
- David foresees more integration of Geo Risk Management with Asset Management in the near future, into Geotechnical Asset Management.
- HA and NetworkRail are very willing to contribute to our questionnaire and to discuss specific items in future meetings.