

Krebs Ovesen Memorial

**GEOTECHNICS in
MODERN SOCIETIES**

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Deltares
Building Delta Life

GeoDelft

Deltares
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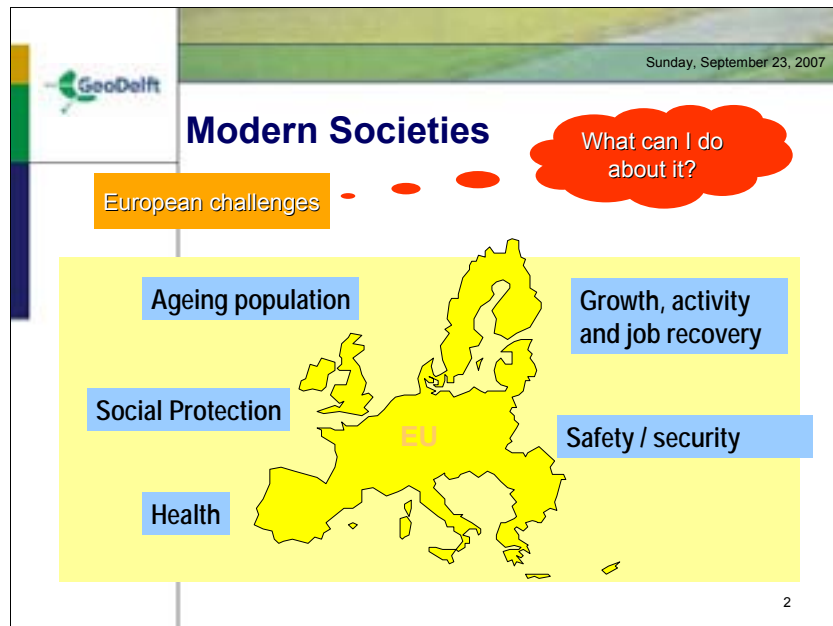
Sunday, September 23, 2007

Geotechnics in Modern Societies

- **Modern Societies**
- **Role for Geotechnics**
- **GeoQ**
- **GeoBrain**
- **GeoSenso**
- **GeoEnergy**
- **SmartSoils®**
- **Delta Technology**

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In the spirit of Prof Krebs Ovesen, let us follow his kind and insistent inspiration for a firm and valuable rooting of the geotechnical profession in the present-day society, by establishing a harmonized international design environment in which challenges of today and the future are dealt with in an efficient and creative way. Krebs Ovesen's effort for the Eurocode 7 are notorious in this respect. The present lecture is therefore devoted to the role of geotechnics in modern societies. First, what characterizes modern societies and what differs them from the recent past?, and second, what are some of the prominent challenges and what may be the future of our discipline?



At the eve of the XXIst century, the European Society is facing an overwhelming number of challenges: demography changes, climate change, globalisation, and the gloomy perspectives of declining natural resources such as drinking water, oil. And yet, Society is still expecting better living conditions from its built environment: accessible and comfortable for all, durably enjoyable, flexible to changing demands, available and affordable. We could think of ... More human sciences developing customer focus and human-oriented innovative processes. Information technologies at all levels and advanced design based on modeling and simulation, advanced embedded electronics; advanced monitoring techniques and wireless intelligent sensors; integrated demand and asset management. Nano- and biotechnologies for new multifunctional materials. Communication technologies at all levels streamlining the flow of information and irrigating knowledge. Services offered by satellites for positioning and monitoring works. Great challenges!

The global aspects of the European Policy :

- The Lisbon strategic goal (2000) to become by 2010 "the most competitive and dynamic knowledge-based economy in the world";
- The Barcelona goal (2002) of raising Europe's overall level of research investment from its current level of 1.95 % of GDP to 3 % by 2010, of which two-thirds should be from private sources,

represent a big challenge to the engineering sector, in charge of creating, constructing and maintaining a proper living and working environment with ample place for leisure, growth and nature, in a globalizing world where sharing and competing crosses all borders. Furthermore, social demands must be placed in the perspective of the enlargement of the European Union and development of the single market. Taking into account the continual evolution of the European regulatory framework is an important consideration for any research actions undertaken, in order to anticipate the application of the directives in the context of the sector's activities, to prepare new products and processes which are called for.

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Modern Societies

How do I survive?

Global competition

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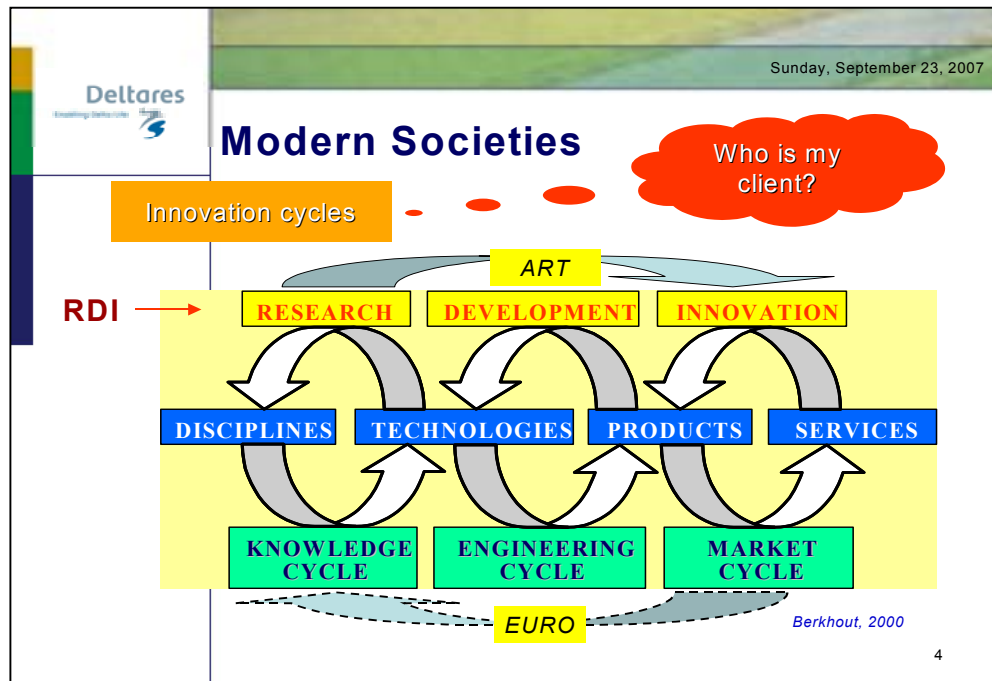
Modern Societies

Am I involved?

Sustainable growth

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At the eve of the XX1st century, the European Society is facing an overwhelming number of challenges: demography changes, climate change, globalisation, and the gloomy perspectives of declining natural resources such as drinking water, oil. And yet, Society is still expecting better living conditions from its built environment: accessible and comfortable for all, durably enjoyable, flexible to changing demands, available and affordable.



Innovation cycles exist in many forms. Here, three of them are shown: knowledge cycle, engineering cycle and market cycle in connection with the subsequent process of performing research, further development for application and finally the innovation itself, i.e. used in practice. Related output are: disciplines, technologies, products and services. It is worthwhile to notice how money flows in this system. From left to right the knowledge (art) flows to social benefit. In the first cycle money is invested and converted into knowledge, usually money from taxes. In the engineering cycle investments are made, either public or private money. In this cycle there should be some clear view on return of investment. In the market cycle the art is converted into money, usually for shareholders. It would be a much better society if the financial loop is closed, as shown in the slide, which unfortunately is not. The return of investment of money invested in the first cycle is very high in the last cycle, in the order of 20 to 40.

Society counts a variety of species, each with its own desire and concern, or motive and fear. Politicians are not interested in money or cost reduction. At present multi-nationals and politicians seem to be dominant. In the near future a response is expected of a new multi-national society. Authorities become nervous from being accused of negligence and carelessness. Industry is in principle not transparent, and for them profit is the drive. It is not easy to convince them that to some extent sharing knowledge is more profitable than hiding it. A strong role is, and probably will continue to be, played by the media. Damage, failure and corruption are magnified in mass media, as a public trial, producing a negative image. Media are however also the perfect carrier of positive achievement and messages, particularly when they inspire emotion. Scientists complain that economic and political forces are undermining integrity. People require security and comfort in a society where risks are increasing because of its dependency on technology. And technology has to provide the answers. There is no way back.

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Modern Societies

How do I communicate?

new agora

drivers and restraints

position
vision
strategy
tactics
authority

Stakeholder	Desire	Concern
POLITICIANS	POWER	VOTES
AUTHORITIES	CONTROL	CAREFULNESS
INDUSTRY	PROFIT	COMPETITION
MEDIA	SCANDAL	NEWS
SCIENTIST	PERFECTION	IGNORANCE
PUBLIC	SECURITY	COMFORT
NATURE	EXISTENCE	EXTINCTION

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Decisions are made in this new agora where the context is defined, where public and private interests meet, where different opinions emerge, and where – if they want to play a role – geo-engineers must raise their voice. If we express our added value in correct wording, in a context easily understood, our position will gain strength and the value it deserves.

The actual framework program (nr 6) runs for 7 years and contains the following main topics 1. Cooperation (32 billion euro) 10 themes, 2. Ideas (7.5 billion) ERC, 3. People (4.5 billion) a.o. MarieCurie, 4. Capacities (4.2 billion) 5 themes, Joint Research Centre (1.7 billion).

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What is my pollicy?

EU R&D frame

In 2000 in Lissabon the EU member states decided to create a single EU area for R&D (ERA) and that EU becomes the most competing and dynamic knowledge economy in the world by:

- supporting network capacities and facilities in selected area's
- scientific and technical support to policies
- promoting (tomorrows research) excellence

The Framework Programs are important instruments and they offer support for international cooperation in R&D.

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Modern Societies

ETPs

Who is my partner?

<p>EuMaT Advanced Engineering Materials and Technologies</p> <p>ACARE Advisory Council for Aeronautics Research in Europe</p> <p>ARTEMIS Embedded Computing Systems</p> <p>ECTP European Construction Technology Platform</p> <p>ENIAC European Nanoelectronics Initiative Advisory Council</p> <p>ERRAC European Rail Research Advisory Council</p> <p>ERTRAC European Road Transport Research Advisory Council</p> <p>ESTP European Space Technology Platform</p> <p>ESTEP European Steel Technology Platform</p> <p>FOOD Food for Life</p> <p>FORESTRY Forest based sector Technology</p> <p>MANUFUTURE Future Manufacturing Technologies</p> <p>FTC Future Textiles and Clothing</p> <p>GAH Global Animal Health</p> <p>HFP Hydrogen and Fuel Cell Platform</p>	<p>ETP Industrial Safety</p> <p>IME Industrial Safety Innovative Medicines for Europe</p> <p>ISI Integral Satcom Initiative</p> <p>eMobility Mobile and Wireless Communications</p> <p>NanoMedicine Nanotechnologies for Medical Applications</p> <p>NEM Networked and Electronic Media</p> <p>NESSI Networked European Software and Services Initiative</p> <p>Photonics Photonics21</p> <p>Photovoltaics Photovoltaics</p> <p>Plants Plants for the Future</p> <p>EUROP Robotics</p> <p>SusChem Sustainable Chemistry</p> <p>WSSTP Water Supply and Sanitation Technology Platform</p> <p>Waterborne Waterborne</p> <p>ZEP Zero Emission Fossil Fuel Power Plants</p>
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Modern Societies

ECTP

Where is my chance?

ECTP is an initiative to mobilize the construction sector, to be changed through RDI, in order to satisfy the needs of the society

An industrially driven platform with the commitment and the contribution of all the stakeholders, in order to reach the 3% GDP on research (1/3 public; 2/3 industry)

VISION 2030
SRA
IAP

↪

Underground space
Reduce impact
Sustainable networks
Attractive Europe
Added value

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Recently the construction sector organized itself on European level in the ECTP (European Construction Technology Platform), recognized by the European Commission. It produced a vision document Vision 2030, which has been composed from discussions and contributions of a few hundreds of top engineers of European companies, institutes, etc. It also produced next to that the so-called Strategic Research Agenda, which contains many suggestions that should be considered when realizing the Vision 2030. To achieve this research has to be undertaken from now. Recently, it produced the Implementation Action Plan, which is a kind of time schedule of prioritized research proposals. This action plan will be considered by the EC when formulating the Calls for the running and future research framework programs (see www.ectp.org).

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Modern Societies

Am I involved?

ECTP FAs

- Underground Construction
- Cities and Building
- Quality of Life
- Materials
- Networks
- Cultural Heritage
- Processes & ICTs

segments of industry

Implementation
Action Plan

7

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Modern Societies

The future belongs to the youth

View of YELGIP

Professional environment

Decision-making support and risk management

Life-time learning and working environment for students and professionals.

New generations

New generation engineers: sharing knowledge and experience in a healthy competitive environment

New generation policy makers: base decisions on expertsystems

New generation design models: combining soft and hard data, and uncertainty

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The structure of the ECTP consists of so-called focus areas (FA), object driven and generic.

For further information Bas Hemmen can be contacted. He is the EU-Liaison of ELGIP. b.r.hemmen@geodelft.nl

YELGIP is the Young European Large Geotechnical Institutes Platform established in 2004 by ELGIP. Participants in YELGIP are promising researchers - engineers from ELGIP institutes younger than 35 of age.

They organize exchange programs and workshops with a focus on meeting young industrials.



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Role for Geotechnics

Facts

High uncertainty

Failure driven

Subcontractor's role

Discipline orientation

Low profile in society

No firm role in the decision process

Most construction projects suffer 10 to 20% cost/time exceedance, which for 50% is due to insufficient geotechnical concern

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Role for Geotechnics

CO OPERATION

ELGIP

Institutional R&D policy

GEO	Denmark	Niels Krebs Ovesen,
GeoDelft	Netherlands	Joost Wentink, Frans Barends
LCPC	France	Jean-Pierre Magnan
LNEC	Portugal,	Pedro Sêco e Pinto,
NGI	Norway	Suzanne Lacasse, Knut Andersen
SGI	Sweden	Göran Holm,
ILG	Germany	Rolf Katzenbach
CEDEX	Spain	Vincente Cuellar
BRE	United Kingdom	John Powell
ISSMGE	Belgium, World	William van Impe, Neal Taylor


- PROPER RECOGNIZANCE IN SOCIETIES
- PARTICPATE IN INTERNATIONAL NETWORKS
- LEAD IN GEOTECHNICAL R&D POLICY AND DIRECTIVES
- TOWARDS COMPLEMENTARY TRANSNATIONAL INSTITUTES
- ATTRACTIVE IMAGE FOR PROFESSIONAL CONTINUITY
- BRIDGING SCIENCE AND PRACTICE IN GEOTECHNICS

Istanbul, 29 August 2001

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An informal meeting in Istanbul 2001 was the start of institutional cooperation in European states. It lead to the establishment of ELGIP in 2002. ELGIP regroups prominent research organizations from European countries working in the field of geotechnics, one representative institute per state. ELGIP provides an operational framework for the promotion, exchange and integration of expertise, experience and efficiency within a common policy for research, development and innovation. ELGIP is established for society, mankind and nature, to assess, prevent and mitigate at European level the effects of construction costs and risk, effects of natural hazards, and effects of regulations and methods ... in the field of geotechnics (see www.elgip.net).

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Role for Geotechnics

CO OPERATION
GeoTechNet
EU project FP5

Research Organisations		Contractors		Consultancy	
CUR	NL	BNI	NL	ARUP	GB
BBRI	BE	BESIX	BE	GEO	DK
BRE	GB	DRAGADOS	ES	JH Geo	SE
CEDEX	ES	EDRASIS	GR	JMA	BE
ENPC-CERMES	FR	MT Hojgaard	DK	Geo Engineering AB	SE
GeoDelft	NL	NCC	SE	VIATEK	FI
IBDIM	PL	SOLBAC	FR	WB & P	GB
LNEC	PT	INTRAFOR	F		
NGI	NO	ZÜBLIN	DE		
SGI	SE			Higher Education	
TRL	GB	End Users		UNICAN	ES
VTT-INFRA	FI	English Partnerships	UK	UCAM-DENG	GB
				TUD	DE
Supply Industry		Infraestructuras Madrid	ES	IGB-TUBS	DE
RBTBS	FR	RWS	NL	TCD	IE
EFFC	FR	D'Appolonia S.p.A.	IT	VGITU	LT

Database

Eurocode

Design tools

Environment

Site safety


hazards

GeoTechNet, November 2005
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A leading research/policy achievement was produced by the EU-project GeoTechNet (running under FP5) (see www.geotechnet.org).

Joost Wentink, an experienced contractor and consultant, and not a geotechnician but acquainted with geotechnical specialists as former director of GeoDelft, stated: “Without exception, if you work in the construction sector, in any function, you will be confronted with the aspect soil. Every project seems to get a calamity, small or large, related to soil. I thought that after such an event the soil mechanics advisor was wrong, but now I know that every advisor could be right. The difference is the individual risk perception related to the intrinsic large uncertainty in soils.”

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Role for Geotechnics

PERCEPTION
awareness

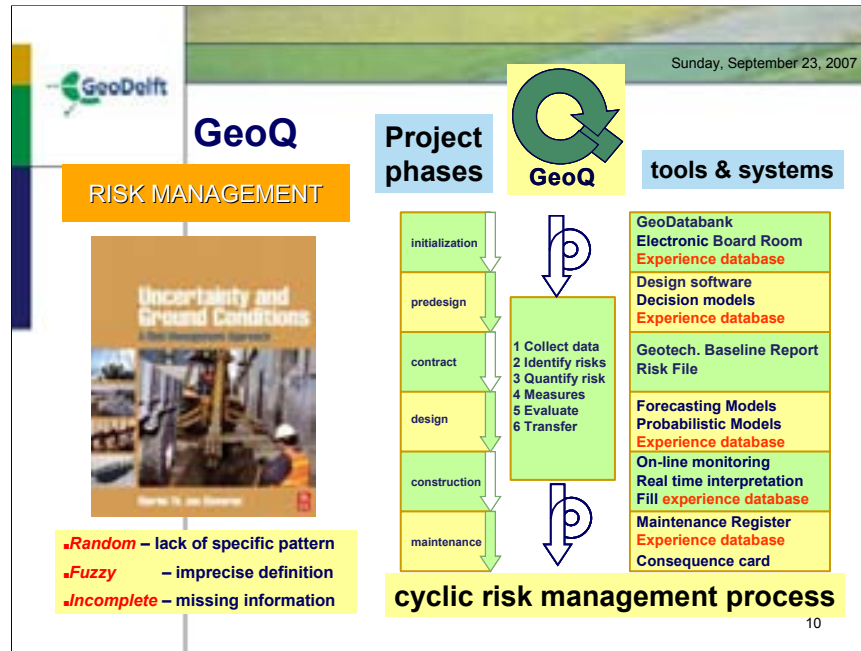
**“Any construction project deals with soil;
every project seems to get a calamity,
small or large
related to soil**

The soil advisor is usually wrong? NO!

**It has to do with risk perception
related to the intrinsic large uncertainty in soils.**

Risk perception

Wentink, 2000
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The unavoidable ground-related uncertainty, as encountered in any construction project, is put by GeoQ in a structured risk management framework. Risk management aims to minimize failure and costs and maximize purpose and quality by in-depth expertise and experience, cyclic risk management process, and attention to the people factor (communication, dealing with risk perception).

Risk management per project phase determines which ground information is necessary for a successful construction project.



Phase 3: allocating contractual ground-related risk, despite fuzzy ground with random properties and insufficient information, b.e. Geotechnical Baseline Report (GBR).

Phase 4: managing risks in the ground during design (cause reduction) or during construction or utilization (effect reduction), b.e. Failure Mode and Effect Analysis (FMEA), followed by a detailed and risk-driven site investigation.

Phase 5: managing ground risk and opportunities, b.e. observational method.

m.t.vanstaveren@geodelft.nl

Betuwe Railway Project. By risk management following the GeopQ philosophy the project remained within planning and within the budget (27 M€ saved!). The extra investing on 0.2 M€ on monitoring saved 4 M€ on sheet piling. A return on investment factor of 20 (ROI).



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Deltores

GeoBrain

systematic learning from failures and successes

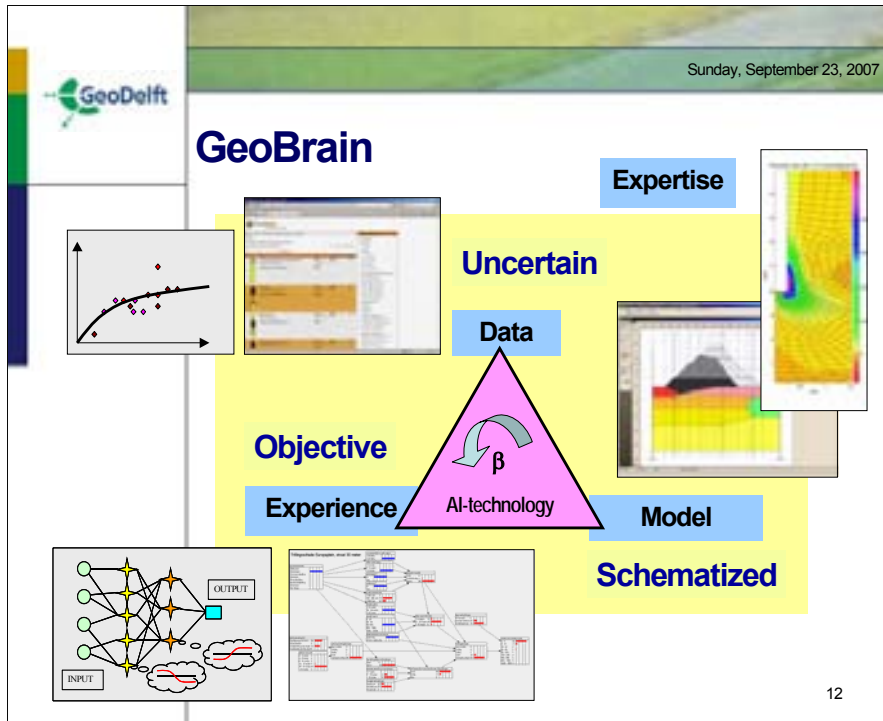
framework for experience exchange

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The start of large-scale infrastructural projects and, thereafter, the design and construction become more and more complex. Policies concerning multi-functional space use a sustainable building, integral approach of projects, procedures and licenses, existing cables and pipelines, pollution and archeology emphasize that in general the subsoil represents the greatest risk in construction and maintenance. The situation calls for quick and comprehensive answers with the adoption of all available expertise and experience, presented in clear and understandable manner.

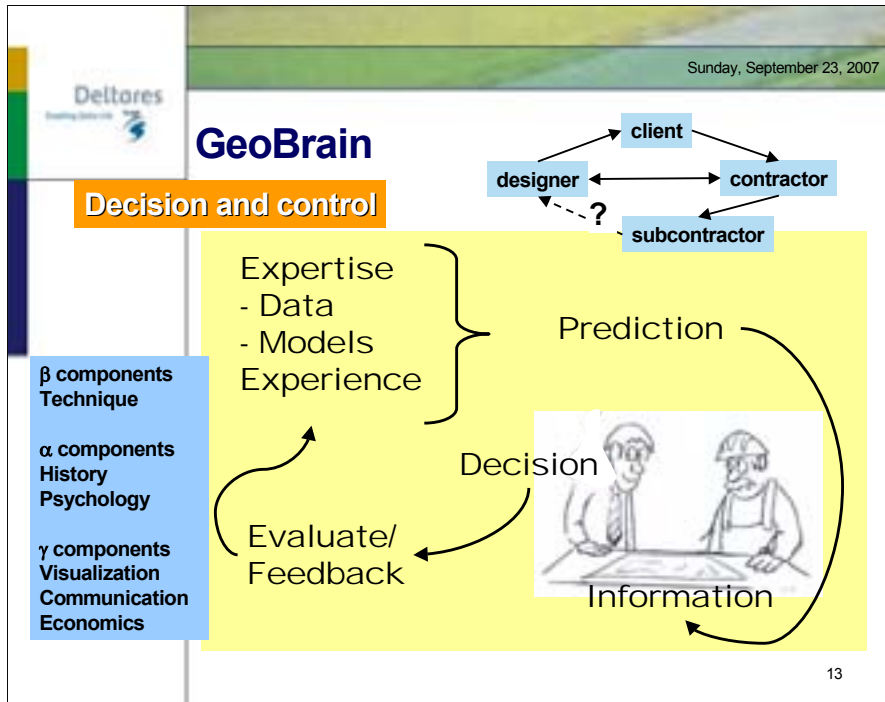
GeoBrain, provides a toolbox for the integral approach of complex situations where the subsoil is an important risk, leading to a view on the objective and reproducible consequences of choices. This development has a strong parallel with some other disciplines, like in the medical science where with diagnostic systems empirical knowledge is being translated into generally applicable concepts. The present-day ICT makes this approach possible.

GeoBrain closes the gap between theory and practice. It is aimed directly at reducing uncertainty and the costs of failure, thereby increasing the quality of profession and minimizing the risk in geo-engineering works. GeoBrain forms a unique facility, the brain-side complementary to common physical and numerical facilities. By artificial intelligence, by neural networks that create new relations between the various knowledge sources and by coupling of numerical prediction models and physical tests the complete set of data interpretations, predictions, practical experiences, expert views and test results can be translated into objective information. For the information transfer the latest presentation techniques are applied.



The gap stems from the fact that there has been, hitherto no possibility of systematic learning from case histories of completed projects. Practicing engineers have, from time to time, proposed ad-hoc rules and equations based on experience and field observations but no unified framework of disseminating has been available to engineers till now. In recent years, the development of the tools of computational intelligence such as fuzzy logic and artificial neural networks etc. make it possible for engineers to analyze field or 'monitored' data of construction and truly apply 'observational' methods as recommended by various codes of practice. Up to now geotechnical institutes and engineers have concentrated on the development of computational prediction models to simulate the observations of engineering practice, sometimes with limited success. GeoBrain aims at bringing the vast experience on various aspects of foundation construction together and make it available to design and practicing in the form of readily usable tools for closing the gap between theory and practice.

The general objectives are to decrease risk in construction projects, reduce losses, improve the image of contractors and geo-engineers, improve working conditions, ensure completion of these projects without unforeseen delays and last but not least the reduction of insurance fees. Especially in foundation engineering and the drilling technology it is hard to insure projects. Insurance fees are high and most of the times the policy does not cover major failures.



GeoBrain is addressing these problems directly by developing an experience database from case histories and disseminating these experiences via the Internet. This database, complemented with expert knowledge, can be used to make predictions with an Artificial Intelligence (AI) based methodology. There are therefore two kinds of output from the total GeoBrain system: experiences and predictions. Experience in its context can be objectivated using obligatory questionnaires, which have been composed together with the users and providers (dropdown list). Predictions are made using a Bayesian Belief Networks, built from expert knowledge and validated by the real case experiences. The Internet is the ideal medium to display the experiences and the results of a prediction (visualization). Assigned users can search on act type or via a map on location. Afterwards queries can be refined. The predictions can be made on the same website.

The participating work groups for foundation engineering and drilling technology consist of several contractors and experienced people from engineering consultancies. Together the questionnaires were made and experts deliver their knowledge for the prediction models. On the input side the clients stimulate the contractors to deliver their data. This is done via the specifications of projects and standard contracts. On the output side the main stimulators are the insurance companies. If a contractor or a client can prove with the use of the prediction models and experience database that there is less risk involved in his project, the insurance companies have a better insight in their risk and are therefore sooner willing to insure the project against a lower fee and or a lower own risk rate.

GeoBrain

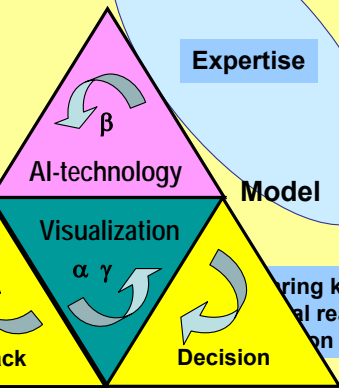
Combine and improve existing multi-disciplinary knowledge (expertise and experience) into usefull information for decision making and risk control.

All aspects
All stages
All involved

Experience

Data

Expertise



Unique combination of (objective) hard data and models with (subjective) soft experience / intuition

...ring knowledge EBR
...al reality, gaming
...on support system

Efficiency

The users of both the database and the prediction models are: engineers working in client organizations, consultants and contractors, the operating contractor, expertise agencies and risk controllers.

Based on the collected experiences the evidence of failure to surrounding utilities and foundation elements is present in at least 40% of all cases. GeoBrain does promise to make a real difference in geo-engineering and will help the designers with a structural use of experiences. Future plans for GeoBrain are to widen the topics and to internationalize the use.

More information can be obtained from m.korff@geodelft.nl



Mandy Korff

Sunday, September 23, 2007



GeoSenso

System actuators



Advanced communication and sensor technologies are tested in the field to see their suitability to keep structures permanently in optimum shape at low cost and robust

An observational method for managers

See the seemingly unmeasurable

Calibration dike project




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The IJkdijk (calibration dike) emerged as a joint initiative from the sensor and information technology sector and the geotechnical society. It comprises a number of field tests on full-scale embankments, aiming at various failure mechanisms, in order to improve knowledge of these mechanisms and to prove the effectiveness of new sensor techniques under realistic conditions.

The first large scale tests aim at slope stability, to be carried out on an embankment of 5 m high and 100 m long. The international geotechnical society is challenged to predict when failure will occur.

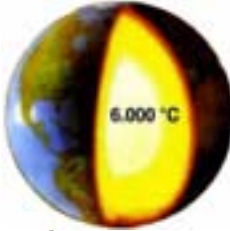
Would you like to
join the
international
calibration test

Construction and sensor installation will be completed in November 2007. Documentation and instructions for prediction will be available in December (www.geodelft.com/prediction). January 31 deadline for prediction submission. February-March 2007 tests will be carried out. (info: a.r.koelewijn@geodelft.nl)



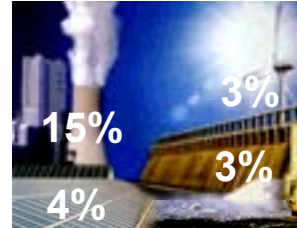
GeoEnergy

Kyoto convention



- 99% hotter than 1000°C
- 0.01% cooler than 100°C
- heat gradient 3°C/100m
- ground is an isolator

- 75% fossil fuels
- 20% CO2 reduction ?
- 35% energy consumption for heating / cooling buildings
- 1% energy consumption lightening in buildings

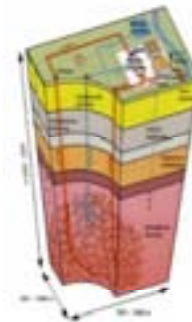
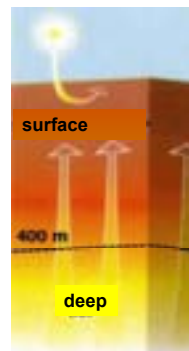


WE LIVE ON A HUGE STOVE

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GeoEnergy

Multi-disciplinary



Low and high enthalpy heat exploitation

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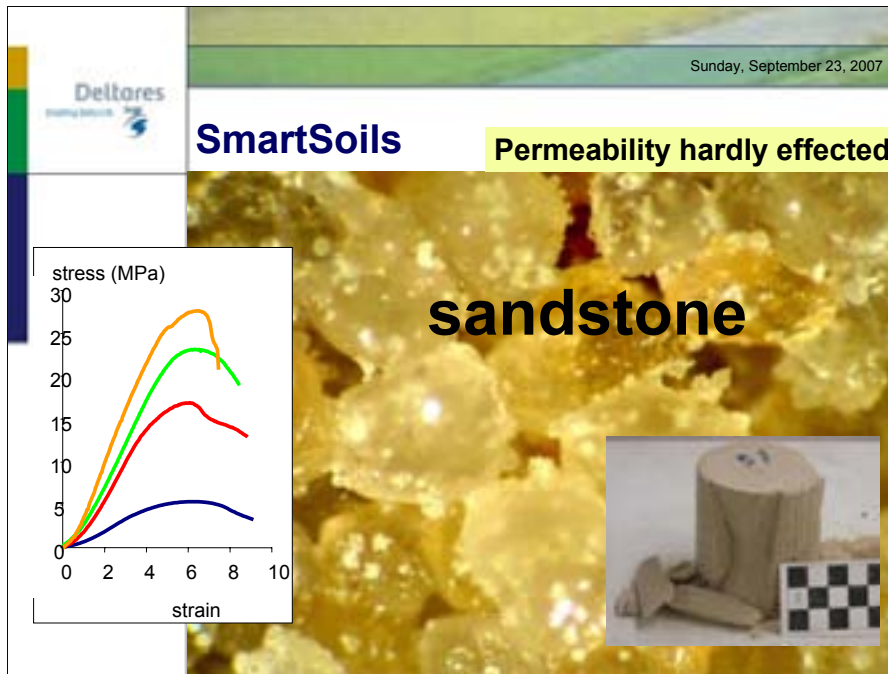


Rolf Katzenbach

Geothermal energy is a promising solution for the rising global energy problem. Beside shallow heat and cold storage, the deeper earth warmth becomes available with the development of smart wells in the oil industry and higher oil prices. Spatial planners are inclined to consider sustainable energy aspects.

The coming EU directive on soil will probably be a stimulant. Soil mechanics, geohydrologist, geologists, ... and many other disciplines should join forces to provide this elegant energy solution.

(katzenbach@geotechnik.tu-darmstadt.ge)



SmartSoils® are technologies that can direct the localization and rate of natural soil processes that influence soil properties. By influencing these processes, there is real potential to alter the properties of the soil (for example, permeability and stiffness). Thus, by means of bio- and nano-technologies, we can generate soil to suit a desired purpose, such as changing the natural soil to make it suitable as a foundation for construction. Some examples from SmartSoils® Toolbox:

- Biosealing: a natural biological process for self-detection and sealing of seepage in water impermeable barriers; specific bacteria appropriately fed will do the job in some weeks time; it has been successfully applied in practice.

- Biogrout: in-situ cementation of permeable soils for strength improvement with retention of permeability; bacteria form sandstone in just a week or so!

Black Clay: active carbon/clay organic barrier for isolating material from the environment

- Drillmix: Fluid for horizontal directional drilling that is suitable for use in salt-water; it has been successfully applied in practice.

- ETAC: Two-component grout system with an adaptable hardening time for efficient tunnel boring, even in impermeable soils; it is successfully applied in tunnelboring operations.

Preliminary SmartSoils® research for the improvement of soils via biological methods is under investigation in the following areas:

- Organic clay;

- Peat-containing soils; recently a promising method has been found to stop peat oxidation and the corresponding land subsidence.

- Contaminated and uncontaminated dredged sludge.

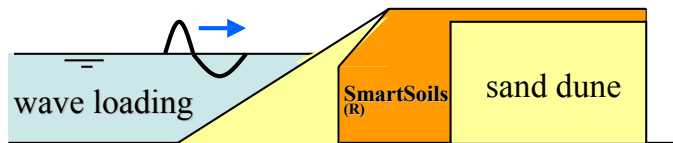
SmartSoils

Soil on demand

Nanotechnology
Biotechnology
Soil chemistry
Geohydrology
Geotechnics



Coccolithophores



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Smartsoils® is a new promising chapter in the history of soil mechanics. By involving the biomass in soil (1 kg soil may contain 10^9 to 10^{12} bacteria), i.e. letting it work for us by proper nutrients in an optimum chemical ambience, natural processes can be enhanced and controlled. This has been proven at laboratory scale and in some cases also in practice (Biosealing, Etac). Development at large scale within existing technical, environmental and juridical borders is the challenge for the future.

In the Netherlands Biogrout (creating sandstone) is being considered to strengthen dunes against erosion.


Waldo Molendijk (w.o.molendijk@geodelft.nl) is the leading engineer for the Smartsoils® developments. He suggests that it is a perfect topic for a joint technical committee (JTC), since here multi-disciplinarity is indispensable.

Shall we make a JTC on Smartsoils?



Waldo Molendijk

Sunday, September 23, 2007



Delta Technology

Geotechnical engineering is an embedded technology

- Low visibility
- High impact

Break through on social items

- Sustainability
- Climate (hazards, energy)

by
nano, senso, biotechnologies
and geothermics

A new Dutch knowledge institute composed of

- GeoDelft
- WL | Delft Hydraulics
- TNO building and underground
- RIKZ coasts and sea
- RIZA water management
- DWW roads and water defence

**will be founded in 2008, named
DELTAIRES**

Multi-disciplinary approach

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The Netherlands is a low-lying country being jeopardized by rising sea level and soft soils. A proper approach for the development of infrastructure etc. requires multi-disciplinarity.

The Dutch government, leaning on various research organizations for its support on this matter, decided to merge several large institutes into one organization and by doing so creating a multi-disciplinary ambience.

In this new institute, called Deltares which officially will start on January 1st 2008, geotechnics, hydraulics, geo-hydraulics, geology are combined from three research institutes and three governmental departments.

The total manpower will reach 800.

Deltares will operate as an independent foundation on the national and international market (R&D and top-consultancy) and with governmental support on so-called national tasks.

(information: peter.vandenberg@deltares.nl)



Peter van den Berg