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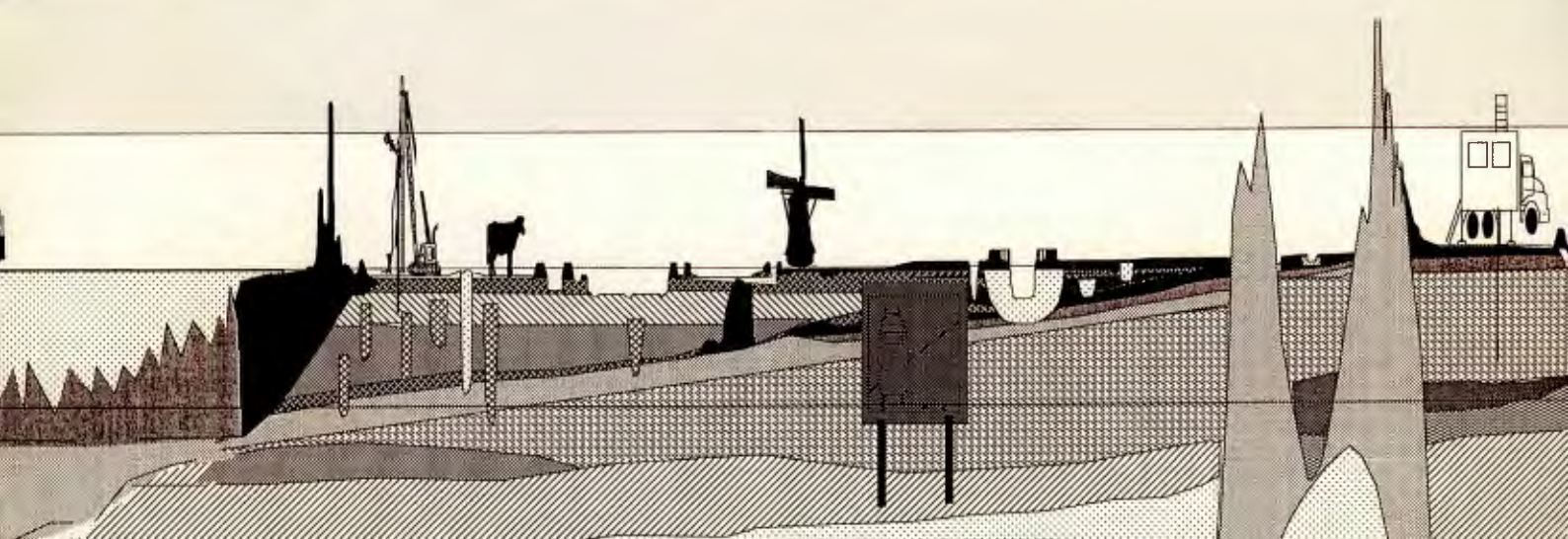
No. 2 Autumn 1995



Objective of the Newsletter

The objective of the Newsletter is to inform the members of the Ingeokring, and other interested parties, on topics related to engineering geology and the developments in this field. The Newsletter wants to make engineering geology better known by improving the understanding of the different aspects of engineering geology.

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Subscription for the Newsletter

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Notes for the authors

- Authors should send their contributions with their names and addresses, as a WP 5.1 text file to the editorial board.
- Authors are free in choosing the subject of their contribution with the following restraints:
  - The subject is related to engineering geology.
  - The manuscript is not a commercial advertisement (announcements are allowed).
- Layout
  - All figures and tables should be handed in as hard copies of high quality, each printed separately on A4 size. The author should remember that figures will be reduced in size.
  - Drawings can be delivered as a separate Drawperfect file or PCX file.
  - When photographs are used, the originals should be handed in (these will be returned)
  - The article should be delivered as a WP5.1 text, without any formatting or layout-codes, accompanied by a hard copy.
  - Each article must be accompanied by a short abstract (< 100 words).

Cover: section through The Netherlands and the North Sea from the Achterhoek to the East coast of England.

From the chairmen of the Ingeokring

Dear Ingeokring members

It is with pleasure that we present you this second number of the Ingeokring Newsletter. The first number was received with enthusiasm by the members of the Ingeokring and we also received positive reactions from a large number of organisations and companies which we send free copies to give information about activities of the Kring.

In this number you will find an invitation to present graduation theses which were prepared in the academic year 1994/1995 at Netherlands Institutions of Higher education. At the annual meeting in spring of next year the (first) prize for the best thesis 94/95 will be awarded. The prize is sponsored by the Ingeokring, Fugro, Rijks Geologische Dienst, Boskalis, Geocom, Iwaco and Ballast Nedam Engineering.

Finally we use this opportunity to inform you that the chairmanship of the Ingeokring has been transposed from Niek Rengers to Robert Hack as approved by the annual meeting in April of this year.

We wish you much pleasure while reading this number of the Newsletter and invite you all to send materials for our next number (to appear in the spring of 1996) to the editor Alexander van de Wall, Faculteit Mijnbouwkunde & Petroleumwinning, Postbus 5028, 2600 GA Delft. Please follow the instructions at the inner side of the cover.

Robert Hack and Niek Rengers

Book review

Rock mechanics on a geological Base

R. Pusch, Developments in Geotechnical Engineering: 77, 1995, Elsevier, Amsterdam, the Netherlands, pp. 498, Price: Hfl. 325, =

The author, who strangely enough has a large background in soil mechanics, succeeds in explaining the relevance of knowing geology when describing rock materials or mass behaviour, specially under civil engineering construction loadings. 'Rock Mechanics on a Geological Base' can be a big help for civil engineers to understand the complex behaviour of rock materials and masses. Also, the theory of rock mechanics is presented in a good way for geologists to understand the geotechnical applications of their knowledge. As an engineering geologist, being expected to know all about it, a good overview of rock mechanics and applications is given, also indicating points of weakness and strength in applied theories.

The publication covers the basics and applications relevant in rock mechanics: The nature and structure of rock, stress and strain behaviour and rock strength and stability. Also, the applications in rock excavation, support and classification are discussed. Each of these topics are introduced at a level understandable by anyone with a background in geology, hydrogeology or related fields.

It should be noted that some of the basics in geology, although covered in this book, are written down in the light of its application in civil engineering. Geologists might think the level of understanding of geology is low, however, I think the author has succeeded to find a balance between explaining geology as a science itself and its use in geotechnical applications.

To go into some more detail, the chapter on rock stability gives an overview of the most well known mechanisms of failure from several viewpoints, including numerical modelling in UDEC and FLAC. Stability is evaluated: First, by semi-continuous failure models (using Mohr/Coulomb's, slice method or Prandtl's failure criteria, for highly fractured and clay infill types of rock masses. On the other hand, using the stereographic evaluation of discontinuity planes considering, amongst others, sliding, wedge and toppling failure.

The chapter on excavation gives a clear explanation about the basic mechanical principles on rock cutting, useful for TBM-techniques, but also for dredging and trenching in rock (although this last application is not covered in this book).

The chapter on rock classification gives a good explanation about the use of these classification systems in the field, their validity and applications in for example tunnelling.

Some credit of this publication should also go to the publisher, who must have gone through some effort to make the lay-out as it now: A typeface that reads comfortably and figures that are large and of good quality. The author also took some effort to select those figures that have no more or less information than was needed to support the text. Furthermore, he does not fear to use some humour either to tell the story in a pleasant way or in using photographs that clearly illustrate the point of discussion and a bit more as well.

Ard den Outer
Delft University of Technology,
Faculty of Mining and Petroleum Engineering
Section Engineering Geology

Engineering geological highlights: engineering geology mapping or information brokerage?

P.M. Maurenbrecher, Delft University of Technology, Faculty of Mining & Petroleum Engineering, Section Engineering Geology, Delft

The highlight for 1995 could be the new-look Newsletter of the Ingeokring. The first edition did not contain, what was hoped to be a regular feature, the 'Engineering geological highlights' column. One reason is that much effort was put in designing the new cover (a combined effort by Jan Reinout Deketh and myself). For Jan-Reinout the highlight of this year must be the presentation of his PhD thesis.

FIRST, NEWS LETTER COVER

Inspiration came from the cover used on the 6th IAEG International Congress proceedings so as to maintain some form of house style. A more realistic profile was used though than on the IAEG proceedings, and it was extended to include the North Sea. The profile extends from the east coast of England (Norfolk) to the German border. It suggests a form of symbolism to do with TU Delft engineering geology professors from the UK and Germany.

The old and present Ingeokring logo.

The new Ingeokring logo which most members may have noticed by now in the latter editions of the red-covered Nieuwsbrief and on the note paper is based on the older logo making use of computer graphics. Hence the triangle on the left represent a cone for the cone penetration test, the most common instrument for site investigation in the Netherlands and on the right the triangle representing a tripod used commonly world-wide for "shell and auger" type drilling. Lower-case letters were used to take advantage of the stepped format "ingeo" which looks more logical than using capital letters.

SECOND, MAPPING

The News Letter cover has a strong "mapping" content for both the cross-section and the globe encompassing the Ingeokring logo. Mapping has a very strong and long tradition in geology and engineering geologists always seem to strive to produce maps themselves. There are two types of maps: those attempting to follow traditional geology: so as to produce say an Engineering Geology Map of the Netherlands. The other maps are working drawings produced to represent some aspect of the subsurface for a specific project or construction job such as defining a sand-body at sea to show its extent for dredging purposes. In reality an Engineering Geology Map of the Netherlands would consist of an Atlas to cover all the possible themes which engineering geology embodies. The cost would be prohibitive in terms of man-years and it is doubtful that such a map would be profitable. Yet there seems to some inert driving force to strive to produce map which would hardly sell or if they do to only a very limited market.

Recently two students have completed their final year projects by producing "engineering geology maps" for two separate towns in the Netherlands. The work is good in the technicalities of producing the maps, usually accompanied by a lament on the lack of data. Both works fail to address the potential market for such maps. In fact has there ever been a marketing study been done to see what the demand would be for such maps?

What will sell is engineering geology data. Bill Gates of Microsoft is hedging his bets for the future on information technology. As the richest person in the world, he should know. Mapping should be substituted with information. Imagine logging into an information source which can tell you all about the data available from past site investigations in a particular location so that if you are planning to build a bridge you can hopefully get an indication from the nearest CPTs or BHs what was found before. A map does not tell you this: it may colour in an area to indicate a soil profile but it does not show the basic data from which that

Auteur(s):	Baart, J. (bijdr.s) / Gemeente Amsterdam, Dienst der Publieke Werken (overige) / Amsterdams Historisch Museum, Afdeling Archeologie (overige)
Titel:	OPGRAVINGEN IN AMSTERDAM; 20 JAAR STADSKERNONDERZOEK
Uitgever:	Unieboek, Bussum, 1977
Onderwerp:	*GS U03 B01 ARCHEOLOGIE. NEDERLAND>
Bevat:	524 blz.
Plaatsnr.:	Bk BK Ned.T 2.Ams.156 (*Bk: Bouwkunde: Architecture*)
Plaatsnr.:	CBmg 10994373 (*CBmg: Centrale Bibliotheek magazijn*)
Titel:	EEN METRO IN AMSTERDAM; uitgave t.g.v. de opening door H.K.H. Prinses Beatrix en Z.K.H. Prins Claus van het eerste deel van de metro oostlijn in Amsterdam op 14 october 1977
Uitgever:	z. uitg., Amsterdam, 1977
Aanteken.:	Metrovoorlichting
Onderwerp:	*WW F02 P02 A STADSSPOORWEG. AMSTERDAM>
Bevat:	63 blz.
Plaatsnr.:	CBmg 17852036
Auteur(s):	Jongers, C. / Bierman, M. (medeaut.) / Heinemeyer, W.F. (medeaut.)
Titel:	GEEN METRO IN DE BINNENSTAD
Uitgever:	Bezige Bij, Amsterdam, 1968
Onderwerp:	*WW F02 P02 A STADSSPOORWEG. AMSTERDAM>
Bevat:	32 blz.
Plaatsnr.:	CBmg 15097078

***Table 1** TU Library database output.*

profile was interpreted or to put it more bluntly: the confidence with which one can use the interpreted data. The data on the underground in the Netherlands is immense, of which some is archived by the RGD, the Geological survey of the Netherlands, some is archived by municipalities and the remainder remains in possession of site-investigation companies and their various clients. Pool this information into a large information data bank the information could be considered more valuable than most banks have capital. Instead of potential clients purchasing geology maps relatively cheaply, produced at huge expense and telling them very little, clients can purchase data from an information bank that has already been financed by a site investigation for another purpose. The costs are no different than banking costs: paying for the cost of managing the data, log-in time and possibly an extra premium depending on the value of the data. The value depends on a number of factors such as oil companies may have paid vast sums for exploration seismics and boreholes obviously do not want to show this to competitors unless they are willing to pay large sums. Another example may be that during slack periods site investigation companies can fill in areas having sparse data, deposit the results in the bank and for those wanting to make use of this information will than have to pay a premium to cover the cost of the investigation. Better still, just as on World Wide Web tabs are kept on the number of "visitors" to ones window . Ard den Outer has a window on a Seismological Engineering Information System" consisting of a discussion box for exchanges of ideas on this subject. He can see the number of visitors he has to this box, even though the visitors may or may not leave messages. Similarly the data bank can keep track of demands for information on certain locations. If these are white areas site investigation companies can see that there is a potential demand for work. Information brokerage?

Future students involved with mapping a town can temper their laments on data sparcity by frequently visiting the data bank and eventually induce a site investigation company to carry out CPTs and bore holes. This should not happen, though, as the data bank should have made mapping obsolete.

To achieve these ends old concepts will have to change and with the year 2000 almost within four years what better monument to geology than making this change. Who knows, it may make geology profitable.

THIRD, UNDERGROUND SPACE AND EXISTING INFORMATION SYSTEMS

At TU Delft we can from our desk log into the TU Delft Network (DUNET) and by summoning a network system called Gopher enter quite a number of libraries world-wide including our own at Delft. Readers will notice that underground space has been featured in newspapers as TGV, Metros and

Schelde road tunnels are all the rage especially using bored tunnels. My contribution has been to write an abstract for a conference entitled underground space and urban planning held in the basement theatres of the Cité des Sciences et de l'Industrie at La Villette, Paris a huge Centre Pompidou type structure. When it came to writing the actual paper (see synopsis in recently published papers section of this News Letter) the organisers had placed the paper in session programme titled Archaeology. Always ready to take on a challenge I logged into Gopher and then into the TU Delft library database. By feeding in key words such as "gemeente", "metro", "archeologie" etc in fields for author, publication title, publisher the system furnished me with the listing shown in table 1.

The first book by Jan Baart, City Archaeologist of Amsterdam, told me the frequency of finds along the first metro line (amongst a wealth of other information). The finds were almost continuous.

The second book devoted a whole chapter on archaeology despite being published as a commemorative volume for the opening of the line by the then Crown Princess Beatrix. It contained one important illustration which visits to the Amsterdam Municipality Archives could not find: underground spaces built in the 17th and 18th century, "reinwaterkelders" or translated into English "clean water basements". Jan Baart mentioned over the phone that there were 33 of them in Amsterdam used to supply Amsterdam with fresh water before a water supply company was established to supply dune-aquifer water. The Amsterdam Municipality is not to be blamed for lack of success: information systems belong to computers and unlike humans cannot offer possibilities based on alternative spelling. It was not Rhijnwater (Rhine water) one should look for but reinwater (clean water). Even then this did not produce a reference in the Delft information system. The word Metro did the trick and a bit of luck.

The archaeologists have an information system called ARCHIS. It has been proven to be very successful..... Any suggestions for an information system for engineering geologists?

FINALLY: JAN REINOUT DEKETH

Up to now TU Delft has awarded three engineering geology PhDs. The latest PhD awarded is to Jan Reinout Deketh last March and has the distinction of being the first to be awarded to an in-house researcher and to a Delft engineer. The first two PhDs went to researchers working at ITC. Hence it is a major highlight. Furthermore Jan Reinout has produced his PhD work in record time and one can admire some of his work in a recent beautifully illustrated journal from the dredging industry "Terra et Aqua" (No. 60 September 1995 page 3 to 7) or purchase his book from Balkema titled "Wear of Rock Cutting Tools, Laboratory Experiments on Abrasivity of Rock". Wear of cutting tools, especially in the dredging industry, is a major cost item and hence any research on this subject should help make dredging more profitable. Costs can be cut still further as rumour has it that this is not the last word (or PhD) on this subject.

Book review

Numerical methods in geotechnical engineering

I.M. Smith, editor (1995), A.A. Balkema, Rotterdam, pp. 432. Price: Hfl 169.60 (hardcover)

The proceedings of the 3rd European Conference on Numerical Methods in Geotechnical Engineering - ECONMIG 94 in Manchester (UK), have been published under the editorial supervision of I.M. Smith.

In general the book gives a wide range of topics related to numerical methods in geotechnical engineering, theoretical as well as practical approaches, which are well presented with respect to lay-out and clarity of the articles. Topics that are discussed and probably have been conference themes are: theoretical aspects and constitutive laws, thermo-mechanical properties, tunnels and pipelines, foundations, foundations and reinforced soil, walls and slopes and rock mechanics.
Some topics are discussed below in more detail.

Theoretical aspects and constitutive laws gives some interesting new developments concerning shear bands in soils and improved models of real soil failure models. Appreciated is the fact that these theoretical advances are tested against the behaviour of the material in laboratory tests. Living in an era of rush-hours in development of numerical methods, it is worthwhile and necessary to reflect on its usefulness and validity in practice, a procedure that sometimes has been forgotten during previous developments.

Foundations gives a large amount of topics ranging from static to dynamic loading on structures and ground. The dynamic loading articles discuss both high and lower frequency loads. The earthquake shaking model of dry sands by Chan et al. has been tested against centrifuge tests and proved to be adequate for low levels of shaking. High levels of shaking (90% of g) resulted in numerical instability, due to lack of damping by the intrinsic damping property of the Mohr-Coulomb model used. The results of an extensive study on the comparison of computer models and laboratory tests for soil liquefaction problems, called the VELACS-project, have been published by Balkema in 1993 under the editorial supervision of K. Arulanandan and R.F. Scott.

Walls and slopes also covers liquefaction problems in slopes. The article by Boughrarou et al. covers the modelling of static liquefaction due to rapid loading conditions during construction. However, this theme, for example, also discusses modelling of sheet pile wall tests, boundary conditions of embankments, anchors retaining walls, lateral pile response, delayed failure of excavations and deep excavations in soft soils. Again these topics are well supported by verification with either laboratory results or field cases.

Concluding this review it can be said that these proceedings give a good overview of common practice in numerical modelling in geotechnics. The numerical approaches used need some background information on general numerical modelling to be able to see the essence of the articles through the lines of matrix and other mathematical notations and styles.

Evaluating the new developments in numerical methods with their opponent of laboratory tests is a necessity, since every development should have some practical use. Sometimes the additional mathematical boogiewoogie needed to explain 1% more of the variance in test outcome, results in a inappropriate method for practical use.
In these proceedings a lot of articles do evaluate the outcome of new models with respect to laboratory test results. Therefor the reader will be able to decide if improvements are good enough to take the effort to learn the more complicated approach to get this improved result.

Ard den Outer
Delft University of Technology, Faculty of Mining and Petroleum Engineering, Section Engineering Geology

Reports on council meetings of the ISRM and the IAEG

E.J.de Mulder RGD, Haarlem (IAEG report) and R.Hack ITC, Delft (ISRM report)

ISRM COUNCIL MEETING, TOKYO, JAPAN 26 SEPTEMBER 1995

The Council of the International Society of Rock Mechanics (ISRM) has met in Tokyo, Japan. The Council meeting was organized on the Sunday preceding the congress, and on Tuesday during the International Congress on Rock Mechanics. The Council is the highest governing body in the ISRM and decides what the policy is of the ISRM and appoints the members of the board, e.g. the president and vice-presidents, of the ISRM. The Council consists of one representative of each National Group of the ISRM, representing the members of the National Group. Normally the secretary of the National Group of the ISRM, for The Netherlands Hans Roest of the TU Delft, attends the Council meeting but on this occasion Hans Roest could not be present and asked me to represent him during the Council meeting. On the Sunday also Professor Dieter Genske (TU Delft) attended the meeting.

The Council meeting on Sunday was fairly uneventful. Candidates were nominated for the different positions of the Board of the ISRM, congresses were nominated to be organized under the flag of the ISRM and the results and proceedings of the different committees of the ISRM were reported. Without doubt this will all be reported and described in the coming numbers of the ISRM Newsjournal which is sent to the members of the ISRM.

A new development is the intention to represent the ISRM on the Internet. However, someone has to make the World Wide Web (WWW) pages and maintain these, and the Council agreed that some financial compensation should be provided. How that can be arranged is not clear yet and has to be sorted out before the ISRM goes onto the electronic highway. The Dutch members of ISRM, e.g. Hans Roest and colleagues, may well get involved in the Internet developments.

The meeting on Tuesday was more exciting as for some of the vice-president positions of ISRM more than one candidate was nominated so that on the Tuesday the Council had to vote. The nominated candidates had expressed their ideas about the future of the ISRM in statements published in the ISRM Newsjournal (1995, 3, 1). For Europe were nominated Giovanni Barla and John Hudson. Both are excellent scientists and have done a lot of good work for the ISRM. The latter expressed in his statement the idea to abandon the multiple languages in ISRM, e.g. to abandon French and German as official ISRM languages. Clearly this provoked some of the other Council members, in particular the representatives of French speaking countries. Whether this was the reason that Barla was elected is not clear as the ballot is secret.

Another excitement in the meeting was caused by Ove Stephansson, at that time Vice-President of ISRM for Europe. He gave a statement in the ISRM Newsjournal which condemned the nuclear tests of France in the Pacific. His view is that this should also concern the ISRM as the nuclear tests and the possible resulting radioactive pollution will be governed by rock mechanical processes, such as breaking up the rock mass and flow through discontinuous rock masses. The French representative requested clarification whether this statement was an official ISRM statement or a private opinion of Ove Stephansson. According to the French representative the Ambassador of France for Japan and the French Government were very 'unhappy' with the statement. The board of the ISRM did not want to subscribe the statement with the argumentation that the ISRM is not a political body. It may have been of influence that the next ISRM congress is scheduled for Paris. Not unlikely is that a vote would have resulted in support for Ove Stephansson's statement as a fast majority of those present supported the views of Ove Stephansson.

In general the council meeting went smoothly. However, the undersigned is of the opinion that the language question should be raised again. Some countries seem to use international congresses as an opportunity to advertise their cultural inheritance, e.g. their language. During the congress in Japan this resulted in embarrassing and irritating situations. Some speakers from France, who I know to understand and speak English fluently, presented their presentation in French. This went even so far that questions asked after the presentation formulated in English had to be translated in French before the speaker wanted to respond. Obviously the answer was in French and had to be translated into English again to be understandable for the fast majority of the attendants. This is a time consuming farce, which reduces the effective time available for the presentations, and more

important it kills any form of discussion. Another argument is the tremendous costs involved in simultaneous translations into two languages, which prohibits the ISRM from organizing congresses with multiple sessions at the same time.

As the ISRM is for rock mechanics rather than a show of cultural inheritance, it is my opinion that a further discussion about the official languages should be initiated.

IAEG COUNCIL MEETING, COPENHAGEN, DENMARK, 28 MAY 1995.

The meeting, hosted by the Danish Engineering Company Rambøll, Hannemann & Højlund, and held in conjunction with the XI European Conference on Soil Mechanics and Foundation Engineering, was opened by the new IAEG President Prof.Paul Marinos. The Secretary-General, Dr. Luis Primel, reported on the membership situation of IAEG which remained stable at about 6.100 members, 3.800 of which receive the IAEG Bulletin. However, the number of Associate Members has dropped dramatically, after scrutinizing this category. From the 10 National Groups in Africa seven are dormant. Senegal has applied for membership and was adopted by the Council.

So far, no editor-in-chief for the Bulletin has been identified which implies that Primel will continue to do this job for the time being. After appointment of a new editor the Bulletin is anticipated to grow into a quarterly journal. The 1995 financial statement shows a substantial deficit of 270,-000 FF due to late payment of dues by National Groups following the recent change in Treasurership, and due to the high printing and distribution costs of the Bulletin. A lengthy discussion was devoted to the question how the IAEG should cope with this phenomenon in the years to come.

After a decade of booming activities the environmental market in the US is now decreasing. Emphasis has shifted from site investigation towards remediation works and risk assessment studies. Engineering geology in Canada is now strongly focused on relief of immediate problems aware to the public at the expense of more fundamental scientific work. The 1998 IAEG International Congress will be held in Vancouver. Preparations are in full progress. With the AAEG (3.000 members) it was agreed that their 1998 meeting in Seattle will be set back-to-back. Asia has 8 IAEG National Groups including a regional group in SE Asia. The Chinese Geological Society is preparing workshops on Geoscience and the Environment. A regional Engineering Geological Congress will be held in Asia in 1997. A venue has not been selected yet.

In Europe, the Scandinavian engineering geologists have requested the IAEG Aggregate Commission, which has abandoned 3 years ago, to be revitalised. In the IAEG Landslide Commission Chairman Cruden was succeeded by Krauter. The 'landslide topic' being a joint venture between the IAEG, the ISSFME and the ISRM, has entered the

IUGS as a Working Group. The IAEG Commission on Underground Disposal of Wastes has almost completed its work and a final publication will be published in Episodes shortly. In addition, this Commission will hold an Expert Workshop and Training Course on Waste Disposal and Environmental Management in Hungary, in September 1995, together with UNESCO and COGEOENVIRONMENT.

The ISSFME is in the process of changing its name. After a long discussion on the distinction between the three dominating groups (ISSFME, ISRM and IAEG) in this field, the IAEG will advise the ISSFME to avoid the term 'Geotechnical Engineering' in their title. The IAEG Executive Committee and the International Council have assessed a set of key issues for the IAEG in the next term (1994-1998), comprising the 'Environment', modification of by-laws, relations with sister organisations (IAH, ISSFME, ISRM, ITA, etc.), restructuring the newsletter, revitalise the IAEG's Regional and National Groups, improving the Bulletin, and publication of an IAEG leaflet.

In retrospect, the Past President (Oliveira) presented a final report on the 7th. International IAEG Congress held in 1994 in Lissabon. The Organising Committee was in the position to support 52 participants financially. IAEG will (co-)sponsor 15 symposia in the International Geological Congress in Beijing, 1996. The Megacities Project (in the IDNDR framework) has been cancelled due to the lack of funding. Still, interest was expressed from the Russian side to continue. A state-of-the-art report was presented on the joint COGEOENVIRONMENT-IAEG-IAHInternational Working Group on Urban Geology, which showed booming activities in Asia and the Pacific. The IAEG agreed to work more closely together with COGEOENVIRONMENT, especially in the fields of the environment and urban geology. The next IAEG Council Meeting is scheduled for August 4, 1996 in Beijing.

I.A.E.G.

INTERNATIONAL ASSOCIATION OF ENGINEERING GEOLOGY

The aims of the International Association of Engineering Geology are:
- To promote and encourage the advancement of engineering geology through technological activities and research.
- To improve teaching and training in engineering geology and
- To collect evaluate and disseminate the results of engineering geological activities on a worldwide basis.

The IAEG cooperates with international organisations and has the following major activities:
- Publishes of the Int. Ass. of Engineering Geology, twice a year as an established international refereed journal.
- Operates commissions related to engineering geology
- Sponsors international meetings.

To become a member, please contact the secretary of the Ingeokring: Ir. S.J. Plasman, P.O. Box 250, 2260 AG Leidschendam.

In focus: Brecht Wassing

A.B. de Jong & A. Kooistra

Brecht Wassing (28) has done her official education in Utrecht at the Institute of Earth Sciences (Geology). After four years she decided to go to Delft University to study Engineering Geology. At this moment she is working for the Rijks Geologische Dienst in Haarlem.

"I liked geology very much, but it was very theoretical and Engineering Geology was more a practical study. I wanted to apply my knowledge of geology, and I decided to follow all the engineering geological courses at the T.U. in Delft in order to specialize in this field. Officially I am not an engineer because I graduated as a geologist."

Right after her graduation in 1991 Brecht Wassing went to Great Britain. There she worked for the mining consultant Wardell Armstrong . This company specializes in solving problems caused by abandoned mines. The locations of old mines are often not registered in Great Britain and this brings about difficulties when civil constructions are planned in mining areas.

"I gathered information from the archives of British Coal and if this was not sufficient holes were drilled to search for open space in the underground. If an open space was found the solution was very simple: Pump the hole full of concrete". Old refuse dumps were also of Brecht Wassings' concern during her stay in Great Britain. Refuse dumps used to be sealed off by a clay layer, and are nowadays producing a lot of marsh- gas. No ventilation measures were taken and inside the dumps gas migrates without being able to escape into free air. This can cause explosions and fires. Gravel trenches had to be dug around the refuse dumps to enable the gas to escape.

"After a year I decided to go back to the Netherlands because of two reasons. First, I came in the company without any experience at a relatively low level, and the opportunities to grow within this company were small. I had the feeling that in the Netherlands I could get more responsibilities in an earlier stage of my career. Secondly, I was working in a new department of Wardell Armstrong which still had to search for new assignments, and sometimes there was not enough work to do."

In 1992 Brecht Wassing started to work for Geofox in the Netherlands. This is a consultancy for geology and environment. "My task was to investigate and clean up contaminated sites, mostly near filling stations. This was a very practical job, I was very often in the field; mapping contaminations at the site and giving environmental advise during the clean up operations. The work was very varied and I liked it a lot, but at a certain point I wanted to do more research. The position I had at Geofox did not have much to do anymore with geology, so I decided to apply for a job at the Rijks Geologische Dienst (RGD), district West."

Ir. Brecht Wassing

Today Brecht Wassing works for the department of the RGD, which studies the Dutch soil from 0 to 600m depth. Advise and research are her main tasks. "Now we are trying to make a geotechnical characterization of all the sediments which are defined by the R.G.D. There is a stratigraphical classification but it is difficult to translate this into geotechnical properties. In order to do this we want to measure the simple parameters which are easy to test as: Attenberg limits , shear strength, water content, clay content and unit weight. Next to this we want to characterize the sediments geochemically. The final goal is to create a geotechnical database for the Netherlands. "

Brecht Wassing would like to continue her work at the RGD in the near future. In the far future she might fancy to go abroad again.

On the question what she thinks of the chances for the Engineering Geologists who soon will be finished she answered: "I always have the feeling that I could easily find employment, because of the fact that I studied Engineering Geology next to geology. Companies get more and more acquainted with Engineering Geology and all the Engineering Geologists I know from my time in Delft have found a job. I am sure this will be the same for the next generation of Engineering Geologists"

Ingeokring excursion to the Belgian high speed railway line

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Articles are appearing more frequently in Dutch newspapers with respect to the HST (Hoge Snelheids Trein) (HSR-Hight Speed Railway in English and TGV-Train Grande Vitesse in French). The most recent articles discuss the route between Antwerpen and the Dutch border. This section of Belgium will not profit much from either the costs they would have to invest in the line and the environmental disturbance along the route. The visit, therefore, was an opportune moment to see not only the geotechnical aspects of the present line but often geotechnical problems which would normally not have arisen had it not been for the demands made by the various lobby groups objecting to the NTR proposals. Costs have risen considerably as a result so that clients are apt to accept the lowest priced tender. At Abre, possibly, the contractors (a second has replaced the first) were to eager to appreciate the difficulties they would face. At the town of Halle the project must now, since the construction of the canal over one hundred years ago, be the largest project it has seen. The HSR actually has enabled considerable improvement to the environment around the railway station once construction is finished. In the long term the extra costs may make the HSR less profitable but the profitability of the town of Halle would improve considerably despite the fact that the HSR will not stop there.

On the 11th of October, the Engineering Geology Group from the Netherlands and their counterparts from Belgium visited several sites of the Belgian High Speed Railway (HSR) line from Lille to Brussels. The Dutch Group travelled by bus from Delft to Halle in Belgium where they were joined by the Belgian Group. The members then drove South to the village of Abre the location of the Viaduct.

On the new HSR line from Lille to Tubize (71km) the train is expected to travel at 300 km/hr. On the section from Tubize to Brussels (17km) the speed is limited to 220 km/hr as the line will coincide with the existing railway line. Only a few modifications to the existing tracks will be made on this section. The project, when completed, will connect Belgium with the neighbouring countries. Amsterdam in the Netherlands to the North, Paris in France to the South, Cologne in Germany to the East, and London in England to the West.

In a brief introduction the participants of the excursion were informed on the difficulties encountered in the project. It is politically difficult to relocate people, which means the alignment was constrained and had to pass through some difficult areas. At certain locations rivers had to be crossed while in others the soil conditions were very poor, typically silts and clay silts with high moisture contents. To reduce the moisture content so as to aid compaction, lime stabilization had to be employed in such areas.

The first site to be visited was the viaduct near the village of Abre. A short overview of the project was given by the external relations officer of the Societé National de Chemins de Fèr Belges (SNCB), Fabienne Mahieu. She explained that a viaduct was the best solution in at that location as the track has to cross a marsh, a river and three roads.

The railway line will be carried by concrete beams resting on 3.2m diameter circular columns spanning 53 - 63 m length and arranged in pairs 12m apart. Each pair of columns is founded on a pile foundation comprising 88 micro piles arranged in a rectangular grid 22 m x 8.5 m. The micro piles are spaced 1.5m centre to centre and 8 of them are raker piles 2 in each direction to resist horizontal loads. The total length of the Viaduct is 2km and the maximum height is 11m.

The subsurface consists of soft sediments (10 - 30m depth) overlying carboniferous limestone. The limestone shows some karst features and a variable rock head. Rotary drilling was carried out and micro pile in steel casing socketed 1 - 2 m into the

bed rock. Cement grout was then injected around the micro pile as the casing was withdrawn. The hollow micro pile is filled with cement slurry. In between each adjacent piles cement grout was injected down to the bed rock by means of perforated casing and packers. A pile loading test was conducted on the piles at twice the working load of 110 tonnes. No failures were observed except for some creep phenomena in a few cases.

After the visit to the site at Abre, the group made a stop over for a luncheon in Abre (La Moulin de la Hunelle). The meal was delicious, drinks according to typically good Belgian standards coupled with delightful service. A brief stop was made at Coucou on the way to Tubize. The excursion participants viewed the viaduct over the new HSR line. At this place the new railway line runs parallel to the old line. In the vicinity was the storage site for the materials and shunting rails were being erected.

The next afternoon stop was the construction site of a 'cut and cover' tunnel at Tubize. The geology of the tunnel section consists of loess, sand and Yper clay overlying Silurian shales and sandstones with a high water table. Steep slopes were cut on both sides of the tunnel; 45^0 at the top part and 60^0 at the lower part. The slopes are protected by soil anchors nailed to the slopes and by shotcrete with wire mesh. It is understood that some buildings close to the cutting experienced distress demanding slope stabilization. Trial pumping was conducted to assess the effect of settlement on adjoining structures. These trails, however, showed no effect. The tunnel walls and roof are to be constructed with reinforced concrete. The top of the tunnel roof is almost at the ground level. After construction of the tunnel the slopes will be back filled hence the name 'cut and cover'.

The last stop of the day was the tunnel site in Halle. On this section the HSR line coincides with the existing railway line. After negotiations between the municipality of Halle and the HSR, the HSR agreed to place up to 500m sections of the railway station and the new HSR line underground. Though the costs are high, the town would otherwise have little understanding for a high speed train passing through at speeds over 200 km/hr without stopping.

The subsurface of the site consists of Palaeozoic basement overlain by the Quaternary deposits (loam clay and sands) with an average thickness of 10m. The steeply dipping rocks are characterized by an alternation of sandstone, siltstone and phyllite exhibiting a varying degree of weathering. The depth to the fresh rock is thus variable and local disintegration of rock occurs up to a depth of 25m (figure 1). The tunnel alignment runs perpendicular to the strike of the beds. Mrs Dupont outlined several methods that were employed during the reconnaissance stage and the detailed geotechnical and geological investigation stages. Tests performed include CPT-tests, borings and soundings, dilatometer and lugeon tests, pumping tests and seismic investigations.

The tunnel is constructed by 'wall and roof' tunnelling. The walls are built from secant piles founded on bed rock. Briefly, the method consists of closely spaced cast-in-place concrete piles. Thereafter the spaces in between adjacent piles are filled by another set of cast-in-place concrete piles overlapping its neighbours. A strong barrier wall is thus created. Next, a reinforced tunnel roof is constructed. Excavation of the soil is then carried out in the tunnel and finally a base is put in place. The method of construction is advantageous because the noise and dust are minimized.

In a short speech after the tour, Mr. Robert Hack, chairman of the Ingeokring, thanked our host and the Belgian Engineering Geology Group for their invitation and pledged continual cooperation on future visits.

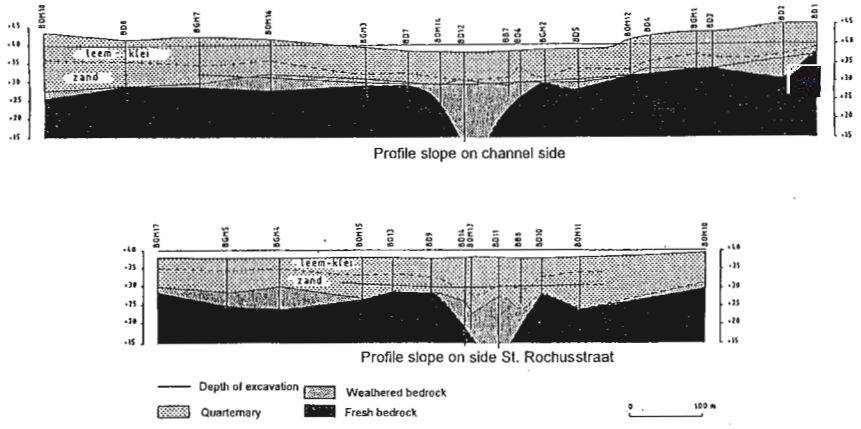

Figure 1 Geological profile along HSR line at Halle.

Unesco coordination programme for disaster reduction through sustainable development

International Institute for Aerial Survey and Earth Sciences (ITC), Delft University of Technology- Centre for International Cooperation and Appropriate Technology (CICAT), University of Utrecht.

On the first of July 1995 the Unesco Coordination Programme for Natural Disaster Reduction through Sustainable Development has been established by the International Institute of Aerospace Survey and Earth Sciences ITC, Delft University of Technology and the University of Utrecht in the Netherlands. In this article the background, aims, tasks and activities of the Programme are described. In December 1995 the Programme will be presented at a seminar about disaster reduction through sustainable development at the Dutch Ministry of Foreign Affairs. Information about the Programme and the seminar can be retrieved from H.J.R.Deketh (address at the end of this article).

NECESSITY OF A COORDINATION PROGRAMME

The almost exponential growth of the world population and the consequent development of virgin and often marginal land, the uncontrolled exploitation of natural resources and exaggerated modifications of the landscape in the name of development have put the environment under unbearable stress. As a result natural disasters increase as well in frequency as in intensity. The global annual death toll from natural disasters is estimated at 225.000 persons and estimates for losses of goods are in the order of 25 billion US dollars per year. In both death toll and losses of goods the last 30 years have shown an annual yearly growth of 6% (Figure 1). In many developing countries, the losses represent 1-2 percent of the gross national product, which may be enough to make the difference between economic growth and stagnation. Annual expenditures in emergency and relief operations are showing an exponential growth sometimes at the expense of funds for pre-disaster measures (treatment of root causes) which are necessary for a sustainable approach to natural disaster reduction.

National and regional policies and decision making in landuse-planning and development should be reviewed in terms of disaster reduction specially in developing countries. Particularly greater attention should be paid to the integration of developmental and environmental aspects in agriculture policies, building regulations, landuse planning, infrastructure design, transportation policies, social security support services, forestry programmes and water resource management.

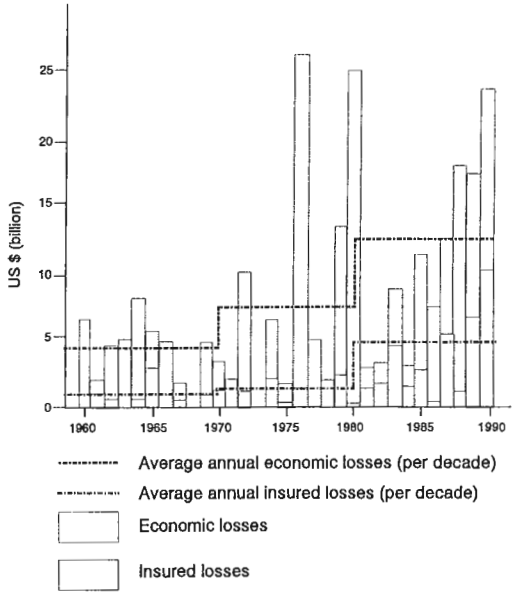

***Figure 1** Economic losses and insured losses due to natural disasters 1960-89 (Source:Sigma 2/90, Swiss Reinsurance Company 1990) .*

HISTORICAL BACKGROUND

At the General Conference of Unesco in 1991 a resolution was adopted which proposed to create a Centre as UNESCO's contribution to the International Decade of Natural Disaster Reduction (IDNDR 1990-2000). As a result Unesco, invited the Netherlands Government to take further steps into the establishment of a management centre of natural hazards and the environment. The nucleus for the Coordination Programme has provisionally been founded as a joint effort of the International

Institute of Aerospace Survey and Earth Sciences (ITC), Delft University of Technology and the University of Utrecht on July 1 1995.

AIMS OF THE PROGRAMME

Objective of the Coordination Programme is to support developing countries in their endeavour to reduce natural disasters by properly understanding the complex relationships between disasters and development, which is then followed by appropriate actions in the planning process:

- by minimizing the vulnerability of the infrastructure and landuse to be developed for the impact of potentially dangerous natural phenomena,
- by proper assessment of the impact of the development process itself on the occurrence of natural phenomena which may lead to disasters.

The revision of landuse-planning policies needs interdisciplinary and international cooperation by sharing expertise and resources. The UNESCO coordination Programme for Disaster Reduction through Sustainable Development can play a role in this cooperation by stimulating the implementation of disaster reduction aspects in landuse-planning by establishing or supporting disaster impact assessment bureaus (DIAB) in developing countries and by acting as an intermediary which coordinates the exchange/application of information between these DIAB's and centers of expertise elsewhere in the world.

TASKS/ACTIVITIES OF THE PROGRAMME

The main tool to reach the objective of the Coordination Programme is to *support the creation and effective operation* of a "national disaster impact assessment bureau (DIAB)" in developing countries. These DIAB's must be well equipped scientifically and technically as well as positioned in the national decision making process in such a way that they can effectively contribute to disaster reduction. The activities of the DIAB's will be tuned to the expertise and knowledge already available in survey organisations, universities, etc. in the developing country. Expertise and knowledge will only be provided by other countries if there is a lack in the developing country itself.
The Coordination Programme will provide support for these DIAB's by:

- supplying advice on the legal and organisational aspects of the creation of a DIAB when necessary.
- providing guidelines for the execution of hazard assessment studies and natural disaster impact audits.
- transferring specialized knowledge on the earth sciences and engineering sciences relevant for disaster reduction which is not yet available in the countries concerned, through:
  - on the job training of national experts in developing countries.
  - training in highly specialised techniques and methodologies in the developed countries.
- provide (access to) a data base on subjects related with disaster reduction.
- assisting the DIAB in formulating project proposals and in finding appropriate partners and financial support through bilateral and/or multilateral funding channels (the clearing house function).
- enlarging the network of institutions/organisations affiliated to the Coordination Programme.
- organising seminars on current issues to inform decision makers and the general public.

CURRENT PROGRAMME ACTIVITIES

During its first year of activities the Coordination Programme will:

- develop pilot projects in a limited number of countries.
- broaden the circle of collaborating and affiliated organisations to cover a large number of countries (to start with in Europe) and a large range of knowledge and expertise applicable in disaster reduction.
- lobby for funding of projects set up in the framework of the Coordination Programme.
- prepare official status and affiliation of the UNESCO Coordination Programme to be agreed upon in 1996.

ADDRESS

Information about the UNESCO Coordination Programme for Disaster Reduction through Sustainable Development can be obtained from the secretariat:

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Durability of geological construction materials

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The terms 'durability' and 'degradation' are widely used in both the field of construction materials and construction engineering. However, one can wonder what is meant exactly with these terms, or how they can be assessed. This article discusses these two aspects with regard to geological construction materials.

DEFINITION OF DURABILITY

The standard definition of durability given in ASTM C119 is 'The measure of the ability of natural building stone to endure and to maintain its essential and distinctive characteristics of strength, resistance to decay and appearance, with relation to a specific manner, purpose and environment of use'. With respect to aggregate this is usually explained as 'the ability of an aggregate to keep its mechanical and physico-chemical characteristics throughout its engineering lifetime under the influence of the engineering environment'. Both explanations note that the concept of durability depends on both the intended purpose and conditions of use, including the time the material has to fulfil its function.

Although a construction material may initially have suitable properties, the influence of the engineering environment may alter these properties. If these alterations lead to the failure of the construction *within* its planned life time, the construction material is not durable. The influences of the environment may be either static or dynamic, and can be of a mechanical or a physico-chemical nature. Physico-chemical processes may induce mechanical forces. The alteration process, eventually leading to failure, is called degradation.

DEGRADATION AND WEATHERING

The term degradation is used to denote the loss of quality of a material under the influence of the engineering environment. This quality can be mechanical, physical or chemical. It should be noted that degradation is time related. The term used to distinguish failure due to the inability of a material to fulfil the engineering requirements from the alteration and possible failure in the course of the engineering lifetime. For example, the failure of a rail road ballast bed due to the unexpected heavy load of a first train concerns the initial properties of the aggregate. However, if the ballast bed fails after a year under normal traffic this is said to be caused by degradation. The repeated impact of trains, the load of the track itself and the influence of the environment have weakened and altered the aggregate. As a result it failed. Another example is the stability of a coastal breakwater. If the breakwater fails under the influence of waves because the shape of the rock blocks prevents a good interlock this means that its initial shape properties are not good enough. However, the repeated impact of waves and the scouring by suspended sand particles may alter the initially good shape properties. When the construction fails, this is due to degradation processes. With this description of the term degradation it can be stated that durability is the ability of a material to resist degradation.

Weathering is also a form of degradation. Weathering is the alteration of natural materials under the natural environment (as opposed to the engineering environment that includes all loads). Minerals are chemical compounds. Like all chemical compounds, minerals may react with substances in the environment (air, water) to form a new compound with higher stability in that environment. It is generally thought that rock weathering does not take place on an engineering time scale. However, this is certainly possible. For example, alkali-silica reactions or the dissolution of gypsum can take place in a very short time span. Certain rocks can alter quickly when placed in a different environment, usually resulting in the presence of clay minerals. Weathering is, to be exact, a so-called degradation process as it leads to a loss of quality. It has been mentioned separately only to accentuate its importance for construction engineering. This importance has been shown by, among others, Fookes (1988), Verhoef (1994), Sims (1991) and Smith & Collis (1993).

DEGRADATION PROCESSES

Degradation takes place during quarrying, processing, stocking and transportation of construction material, but also during its actual engineering use.

Degradation processes that may take place are, among others: abrasion, structural weakening, weathering, production of fines, salt crystallization, crushing, shape and size changes, etc. In other words, all those processes that cause a loss of the initial qualities of the construction material.

For example, the presence of swelling clays in rock, may cause an early break down of this rock if it is exposed to alternate wetting/drying cycles. Minerals that weather may cause volume changes in the rock, or they may degrade to weak minerals. As a result the mechanical qualities will change. The formation of salt crystals in pores and fractures induces tension in the rock due to which it may break down. Due to agitation of loose aggregate abrasion will occur, causing, among others, a change of particle shape. Aggregate used in road wearing courses will get polished due by the action of tires. Armour stones in breakwaters will suffer from the impact of sand particles suspended in the water and from the rocking of the armour stones due to wave action.

DURABILITY RELATED TO TIME AND PURPOSE

Although *all* materials will alter one way or another, they are certainly not always 'non--durable'. The reason is that durability is related to time and to the expected behaviour (purpose) of the material. No one will ask from an aggregate to resist polishing for hundreds of years. Also, durability is demanded regarding those properties that are relevant for a proper functioning of the construction. However, degradation to failure can very well occur within limited time spans.

EVALUATION OF CONSTRUCTION MATERIALS

From the previous paragraph it follows that the following questions are important for the evaluation of construction materials:

- What properties are relevant for a certain application and what are the related requirements?
- How can these relevant properties be measured?
- Do the relevant properties of the rock fulfil the requirements at all (initial properties) ?
- Will the material fulfil the requirements with time (durability) ?

With this small list several very basic problems and complications come to the surface.

Relevant properties and requirements

The first question is what properties are important. In the past, but also very often nowadays, the relevant properties were (at least partially) unknown. The evaluation was/is therefore based on experience. This comes down to the following. Certain materials performed well while others did not. The difference in performance was then explained using the most obvious differences. However, certain materials failed although they were expected to perform well. To prevent as many of such unexpected failures as possible, the requirements were set on a very high level.

The answer to the question of the relevant properties, requirements and specifications is increasingly sought in a so-called functional analysis. This means that the proposed construction is analysed on what functions it has to perform and what this implies for the different components of the construction. For example, the ballast bed of a rail road track should transfer the loads to the underground and form a stable platform for the track itself. This means that it should have and keep a certain shape (in x, y and z-direction) and drain rain water.

To fulfil these functions the aggregate must answer to certain requirements: the particles should somehow interlock to prevent a change in the shape of the ballast bed, they should be so strong that they transfer the load rather than fail themselves, they should form an open structure to drain rain water, and they should prevent fines from coming into the bed as these tend to cause destabilisation. In other words, there are certain properties that are important: particle shape, particle size and strength. The strength relates to different properties though; the material will suffer from the static loading of the ballast bed itself, the track and thermal influences, but also from the impact of passing trains causing crushing and impact failure.

Clearly this approach is coming closer to a rational evaluation of construction material. It is however often difficult to determine all loads imposing on a construction, and even more difficult to determine their magnitude and frequency.

Measurement of properties

Traditionally, construction materials have been evaluated using standard test methods that supposedly assess one or more properties. However, these properties are rarely intrinsic. In other words, the method of the test will determine the value of the result. The unconfined compressive strength, for example, can be regarded as one of the most basic tests in engineering geology. However, the results of this test depend to a great extend on the testing

conditions. An increase in moisture content will result in a lower strength value. Also the rate of loading and the specimen size and shape affect the test result.

This gives rise to the following question: What is the appropriate test (procedure) to obtain a relevant strength value? Not only the way a test is performed is a problem to overcome, for many properties more than one test method is available. For example, the strength of a material can be expressed by the unconfined compressive strength (UCS), but also by the crushing strength (ACV), the tensile strength (BTS), etc.

Many standard procedures attempt to simulate what is taking place in the engineering environment. They should therefore also involve the influence of time and the environment of the construction. This aspect is extremely difficult as it varies from application to application. There is also the problem that a test is always scaled down from reality. This scaling has an additional influence on the behaviour of the tested material. Simulation is extremely difficult and most of these tests are known to relate only in a remote and qualitative way to practice. Several reasons cause this problem: we often don't really know what processes take place, geological materials are highly complex and their properties can be highly variable.

For example, it is common knowledge that relations between different properties and relations between properties and behaviour can often only be established when considering one rock type only and even then the samples should be selected carefully.

Much effort has been put into the identification of those tests relevant to construction engineering. In Europe this is presently repeated for the European standards (CEN). Also in other fields the reconsideration of the evaluation and test methods is clear (CIRIA/CUR,1991, Latham,1991, Stapel & Verhoef,1989). However, due to the problem of scale regarding both physical dimensions and time there is still a large gap between what can be measured and what one wants to know.

Durability

The problem in the evaluation of construction materials is, as just discussed, the identification and interpretation of the relevant properties. Then there is the problem of how to evaluate these properties (what numerical limit should be attached to the results). But there is a third difficulty: not only should the construction material initially have the demanded desirable properties (the specifications), it should also keep these properties during the engineering lifetime of the construction.

The durability of a material is closely related to its properties as discussed before. For example, the abrasion resistance of a rock is determined by its strength and shape. The strength is dependent on the mineralogy and structure of the rock. Often there is also an overlap between durability tests and mechanical tests. For example, the aggregate impact test is generally known as a strength test. However, as impact may alter the shape of the particles it can also be related to durability. One should not worry too much about these difficulties as the purpose of the test result will often show how it is meant to be interpreted.

Another aspect is that durability indicates how well a material resists degradation. However, the durability of a material is not constant. Due to degradation the durability may change which leads to further, or another type of, degradation. An example: the abrasion resistance is dependent on among others, the mineralogy of the material. However, the mineralogy may alter due to weathering (which is a form of degradation). In short, durability and degradation influence each other mutually.

RATIONAL EVALUATION

Durability and petrography

The previous paragraphs discussed some problems in evaluating geological construction materials. It has been shown that the biggest difficulty is the assessment of the durability of a material. The assessment of the durability should depend on the material, time of use and type of use.

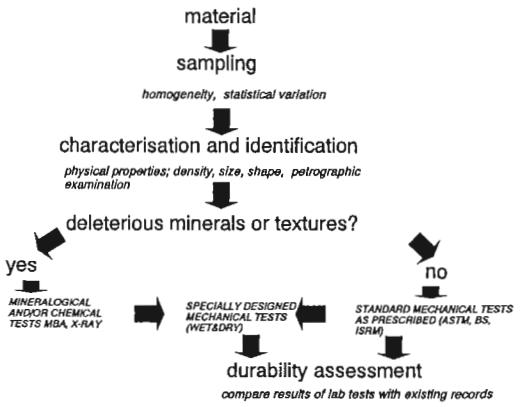

Figure 1 Flow diagram of possible laboratory investigation based on petrographic examination (Pieters et al, 1992).

It has been found that the durability of a material is linked to its petrography. This enables the engineer to establish a testing programme. The

petrography comprises the mineral composition, the distribution of these minerals in the rock, the porosity and other characteristics, such as texture.

By examining these petrographic characteristics, it is possible to decide which test should be performed and to make a statement on its (potential) durability. For example, the presence of swelling clay minerals indicates that alternate wet/dry cycles might lead to failure. Therefore, a wet/dry test may be incorporated in the testing programme. The procedure may look as shown in figure 1. If the characterisation and identification show that there might be durability problems, specially designed tests are performed. Otherwise, the standard testing may suffice. In that case special tests are only performed if the standard tests give problems or if special tests have been asked for.

For example, if the characterisation phase has detected that partially cemented cracks transverse the rock, the magnesium sulphate soundness test might be performed to see if crystallisation of salt may lead to degradation. If clays are present, these can be tested for their swelling properties (Methylene blue absorption test, x-ray analysis).

FUNCTION AND SYSTEM ANALYSIS

Related to this approach is a less rigorous use of test results. Rather than stating exact limits, materials can be classified in terms of excellent, good marginal and poor. Depending on the use and expected duration of loads, the material can than be evaluated for its applicability. This approach should be seen in relation to the functional analysis. (Note that the term functional analysis is sometimes replaced by the term system analysis). Instead of performing a set of prescribed tests of which the results should meet specified limits the proposed construction is analysed. For example, during the construction certain loads are expected, that are not as high during the actual in-service life. By combining this knowledge with the durability properties of the material a more accurate material selection can be made. In figure 2, rock type 1 would perform well, but also rock type 3 might do, if some precautions are taken toward the end of the construction phase. Only rock type two would definitely be out of the question.

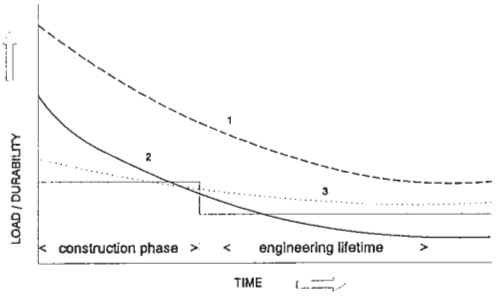

Figure 2 The calculated load on a rock stone structure during construction and engineering life compared with expected durability decrease of three rock types.

PETROGRAPHY AS THE EVALUATION TOOL

The petrography of a rock is the basis for its

Table 1 Main petrographical characteristics affecting engineering test results (After Fookes et al. 1988).

Aggregate Petrography Engineering Test	Mine-ralogy[1]	Hard-ness[2]	Poro-sity	Tex-ture[3]	Shape	Sec. Min.%	Micro cracks	Grain size	Packing
Water Absorption			x			x	x		x
Density	x		x			x	x		x
Compressive Strength		x	x	x	x	x	x	x	x
Tensile Strength			x	x	x	x	x	x	x
Slake Durability		x	x	x		x	x		
Wetting-drying			x	x		x	x		
Freeze-thaw			x	x		x	x		x
Sulphate soundness			x	x		x	x		x
Micro-deval (wet)	x	x		x	x	x	x	x	x
Los Angeles Abrasion	x	x			x		x	x	x
Aggregate Crushing V.	x	x	x		x		x		x
10% fines test	x	x	x		x	x	x		x
Aggregate Impact V.	x	x	x		x		x		x
M.AIV	x	x	x		x	x	x		x
Polished Stone Value	x	x		x	x	x	x	x	x

[1] excluding secondary minerals; [2] indentation strength of composing minerals; [3] including anisotropy. Sec. Min:secondary mineral content.

behaviour. As petrographic properties (characteristics) are intrinsic, they are objective tools for the evaluation of geological construction materials. This may indicate that the evaluation of these materials might be based on petrography only.

Unfortunately this is not possible. Table 1 shows how many petrographic characteristics influence the behaviour of the material. Many different characteristics act simultaneously, and they influence each other. Also, the proper quantification of the petrography is very difficult. As a result the petrography is presently much more a qualitative then a quantitative evaluation tool.

Present and future research is therefore concentrating on the quantification of petrography so it can be used more rigorously. In this respect one should not so much think of linking specific values to the petrographic characteristics, which are then related to the behaviour of the material. One should much more think of classification systems, based on the petrography of the material.

AN EXAMPLE OF A CLASSIFICATION SYSTEM

The polished stone value of aggregates is an extensively researched topic as the test is used as a major criterium for the suitability of aggregate for road surface material. Several petrographic characteristics have been found to influence the polished stone value, of which the most important one is the mineralogy (van de Wall, 1992, Tourenq, 1971).

Table 2 Definition of classes for the polished stone value.

diff hardness	**class**	**rating**
<100	low	1
100- 250	medium	4
>250	high	8
mean hardness	**class**	**rating**
< 300	low	1
300-700	medium	2
> 700	high	3
structure	**class**	**rating**
porphyric	yes	2
non porphyric	no	1
PSV	**class**	
0 - 48	low	
48 - 53	medium	
> 53	high	

Because of the complex interactions of the petrographic characteristics, attempts to correlate these characteristics to the polished stone value have generally not come beyond a qualitative stage. In such cases a classification system may be useful.

For the polished stone value a system can be set up using the mineralogy and the structure of the rock.

The mineralogy can be expressed in a term depicting the average hardness of the rock particle and a term depicting the average differences in hardness of the minerals present in the rock particle, the rock differential hardness (Tourenq, 1971). The structure of the rock can be classified as porphyric or non-porphyric. The polished stone value can be classified as low, medium or high. Table 2 shows a possible definition of the classes with a suggested rating number. The polished stone value is classified with regard to the specifications for road construction in the Netherlands. Road class 1 and 2 demand a polished stone value > 48, road class 3, 4 and 5 a polished stone value > 53. An assessment of the suitability of a rock is obtained by summing the ratings given for all classes.

Table 3 Cross table for suitability rating (SR) and polished stone value (PSV). SR is calculated as the sum of all class ratings.

PSV	SR	3	6	8	9	11	12
	42	1					
low	46				1		
	47	1					
	48					1	
medium	50			3			
	51			3			
	52		1	2			
	53			3			
	55						1
	56					1	1
high	57					1	
	61					1	
	63						2
	65					1	

The classification has been applied to 24 rock samples with varying polished stone values. If the suitability ratings for the samples are compared with their polished stone value, it can be seen that the rating is quite adequate in its identification of the suitability of the samples (table 3). It should be noted that only 3 characteristics are used in the classification system. This may explain those values that clearly deviate from the expected range. Based on the results in table 3 it can be stated that a rock having a suitability rating lower than 6 is likely to have a low polished stone value. Rocks with a suitability rating between 6 and 9 can be expected to have a medium polished stone value, while the polished stone value for rocks with a suitability

rating higher than 9 is probably high. Table 3 shows that 2 samples deviate (SR-PSV = 9,46 and SR-PSV = 11-48). These deviations may be explained by the fact that the classification involves a very limited number of petrographic characteristics. The table also shows that a polished stone value of 53 seems to fit better in the medium group than in the high group.

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Japan study tour 1995

S. van der Woude, JSTC & R.G.J. de Boer, EVC, DIG, Faculty of Mining & Petroleum Engineering, Delft University of Technology, Delft.

In September 1995 the Student Chapter Engineering Geology (DIG, JSTC committee) organised a trip to Japan for a group of engineering geology students and staff of the Technical University Delft. The theme of the study trip was geotechnical engineering. The intention of the study tour was to get first hand information on advanced construction techniques in Japan. Various projects in which engineering geology plays a prominent part have been visited. In this article two topics the excursion are highlighted: marine technology and soft soil tunnelling. The final report on the study tour will be printed by A.A. Balkema. Copies will be available at either Balkema or the DIG - final report committee.

INTRODUCTION

In the second half of September a select group of engineering geology students and staff of the Technical University Delft made a study tour through Japan. The excursion was organised by the Student Chapter Engineering Geology (DIG), Japan Study Tour Committee (JSTC): H. Mannaerts, M.V. Vicente Silvestre M. Vijlbrief and S. van der Woude. Theme of this study trip was geotechnical engineering. The excursion focused on the following topics: site investigation, environmental geotechnics, earthquake and harbour engineering and soft soil tunnelling. Japan was chosen as destination since many advanced geotechnical projects in this country are carried out in difficult geological circumstances, characterised by volcanism and earthquakes.

The intention of the excursion was to visit engineering projects and companies involved with engineering geology. The tour took place between September 18 and October 2. This also gave us the opportunity to send a small delegation of students to the 8th International Congress on Rock Mechanics in Tokyo.

GEOLOGY

The Japanese islands form part of the northwest corner of the mobile belt surrounding the Pacific Ocean. They are located at the border zone between the continental Eurasian plate and the oceanic Pacific plate.

The geology of Japan is largely determined by its geotectonic position. Japan is located near a large subduction zone and is characterised by compressional tectonics. There are many active faults; the constant movements along these faults occasionally cause earthquakes. The active volcanism is also related with the compressional tectonics of this area.

Japan consists of 4 main islands: Hokkaidō, Honshū, Shikoku and Kyūshū. Many small islands are arranged in festoon-like arcs around the main islands. On the continental side, the islands are bound by marginal seas such as the Sea of Japan and the East China Sea. The western Pacific side is bound by the deep oceanic Japan and Koerillen trenches. A great rupture zone called the Fossa Magna traverses the central part of Honshū, geologically dividing the Japanese Islands into southwest and northeast Japan. In southwest Japan, a significant fault called the Median Tectonic Line runs parallel to the Honshū arc, extending from central Honshū through Shikoku to Kyūshū. This fault divides Southwest Japan into the Outer Zone (The Pacific Ocean side) and the Inner Zone (the Sea of Japan side), see figure 1.

The geological structure of the Outer Zone shows great contrast to that of the Inner Zone. The Outer Zone which extends right up to the Nansei Islands is characterized by the occurrence of folded structures and sedimentary deposits, parallel to the Honshū arc.

The Inner Zone of Southwest Japan consists of numerous complex geotectonic belts, consisting of metamorphic, plutonic and volcanic rocks.

In the Inner Zone, acid plutonics which intruded into the Palaeozoic and Mesozoic are extensive. Recent and Pleistocene volcanoes are distributed mainly in Hokkaidō, Northeast Japan, Fossa Magna, part of Southwest Japan and Kyūshū. We visited the Unzen volcano on Kyūshū. This volcano was active from 1991 to 1994. It caused extensive destruction in the vicinity of the village of Shimabara. The Fuji volcanic zone meridionally runs across the main arc of Japan along Fossa Magna. Mount Fuji Volcano, the highest mountain

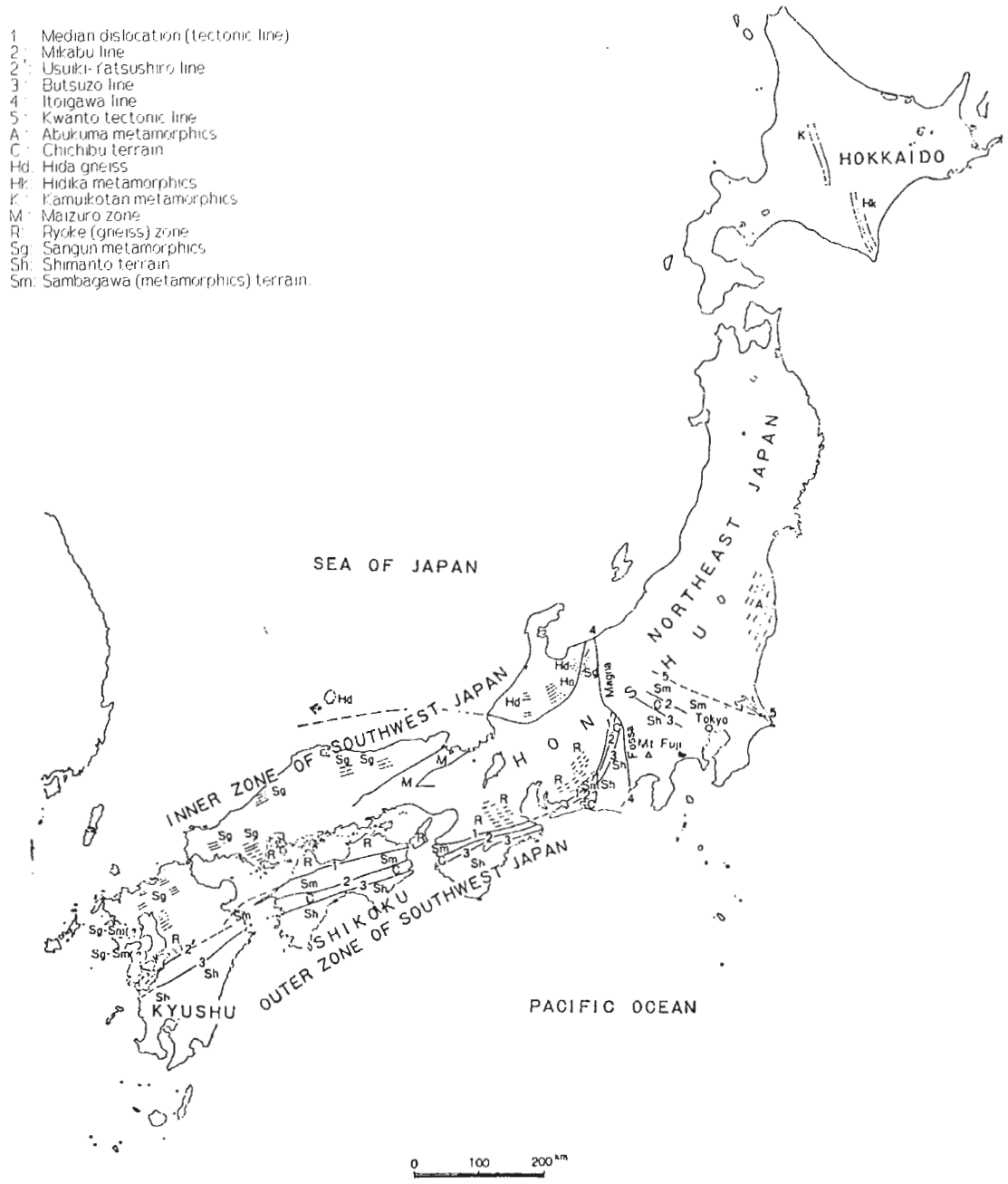

Figure 1 Tectonic map of Japan.

in Japan, has been inactive for more than 200 years.

TUNNEL PROJECTS

Many tunnels in Japan have been constructed in soft ground with tunnel boring machines. During the study tour 5 tunnel construction projects were visited. Four of these tunnels were excavated in soft ground. One tunnel was excavated in mudstone with conventional tunnelling techniques. This was a spiral tunnel constructed as part of the minidome project of the Geotrapolis plans (more details can be found in the final report of the excursion). Two main types of tunnel techniques in soft soil can be distinguished, the Earth pressure Balance shield machines (EPB) and the slurry type shield machines. Generally the EPB technique is used for shallow depths and the Slurry shield technique is used at greater depths.

The Earth Pressure Balance shield technique

Using EPB shield tunnel techniques, the soil in front of the machine is supported by the pressure of

the soil in the excavation chamber. In this chamber the soil is received after being cut by the cutter head. The soil is removed from the chamber by a screw conveyer which is also used to regulate the pressure in the chamber.

A screw conveyor can account for only a certain amount of drop in pressure. When the pressure difference between the Earth pressure and the atmospheric pressure is too high two screw conveyors are used. At greater depths, the slurry type machine has to be used.

The Higashioji Sewer and Subway tunnels (under construction), visited during the study tour, is an example of projects where the EPB shield machine is applied. In the Higashioji Sewer tunnel a new technique was involved: to decrease the friction angle and the cohesion of the soil, foam was injected in front of the cutter head. The final report will discuss this technique in more detail.

The Slurry Shield technique

The excavation chamber of a slurry shield machine is filled with pressurised bentonite. The excavated soil is received in the excavation chamber where it is mixed with bentonite. This slurry is then removed by a pressure pipeline. The bentonite is separated from the soil and returned to the excavation chamber. Examples of tunnels constructed with this technique are the Yodogawa Tunnel for the Katafuku Line and the Trans-Tokyo Bay Highway Tunnels.

RECLAIMED LAND

The population density in the coastal areas of Japan is extremely high. There is a constant need for space. Combined with the high ground prices this makes it economical to reclaim land. For over a century the coast line in urban areas has been extended seaward. The tour visited two reclaimed land sites: Kansai International airport and the Isahaya bay land reclamation project.

Kansai Airport

The construction of Kansai Airport started in 1987 and was completed in 1994. It is a man made island with an area of 511 ha. The depth of the seafloor at this site is 18 m. The seafloor was a soft alluvial clay. To accelerate soil stabilisation the soft alluvial clay layer of 20 m thick was compacted using the sand drain method (an often used compaction method in Japan). The total number of sand piles amounted to 1 million. At revetment areas mixing with cement was applied to prevent settlement. The large volume of earth required for this landfill was obtained from three quarries in granite and sandstone. Only 3% of the fill was obtained by dredging.

According to simulation, ground settlement would be 12 m in 50 years. Because the airport had to be utilized as soon as possible the design of the airport building had to account for the settlement problem. At this moment the settlement is still 1 mm per day. Therefore, a variety of measures are taken for the airport facilities to correct ground level differences due to uneven settlement. The airport facilities rest on a total of 900 columns. At the base of each column, a hydraulic jack-operated level adjustment system is installed to correct for differential settlement, figure 2.

In addition, an automatic measuring system to monitor differential settlement was also provided for each column. When differential settlement is sensed adjustments of max. 300-400 mm are possible with the use of the hydraulic jacks. The building is constructed without foundation piles so as to settle with the island infill, which is referred to as the floating foundation method.

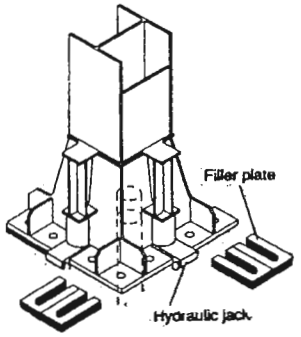

Figure 2 level adjustment system Kansai airport.

Isahaya bay reclamation project.

This project, located on the island Kyūshū, is still under construction and scheduled to be finished by the year 2000. It aims at enlarging the farmland area and increase the agricultural productivity of this region. Another purpose of the project is to solve the problems related to flooding.

The project involves a double dike system as shown in figure 3. It will create reclaimed land by drainage and a catchment for fresh water of 1,840ha and 1,710ha respectively (Comparable with the "Afsluitdijk" and the "Flevopolder").

CONCLUSIONS

The engineering geology study tour has been very educational. The JSTC has succeeded in organising an excursion during which many different types of projects and companies were visited that are concerned with engineering geology. The enthusiastic

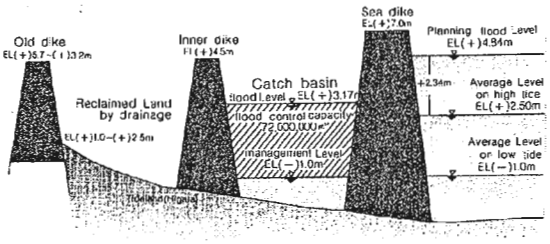

Figure 3 Cross section double dike system Isahaya bay reclamation project.

professionals of many Japanese companies have arranged excellent educational visits for us. It has been their effort that has made the Japan study tour a success. At this moment the final report, which will be published by A.A. Balkema, is being prepared by the final report committee (EVC). To obtain a copy please contact the EVC, tel.: 015-2784651 or Balkema tel.: 010-4145822

AKNOWLEDGEMENTS

Of course the Japan Study Tour would not have been possible without the financial support of all the sponsoring companies. These companies also provided several assignments that were to be fulfilled by the students. We would like to thank the following companies: A.A. Balkema, Geotechnics Holland B.V., HAM, Gemeentelijk Havenbedrijf Rotterdam - Directie Haven Innovatie, Technische Universiteit Delft, Centrum 'Ondergronds bouwen', AKZO Nobel Chemicals B.V., Baggermaatschappij Boskalis B.V., Elf Petroland B.V., Kawasaki Heavy Industries Europe B.V., KIvI- Afdeling Geotechniek, Stichting Timmers Verhoeven Studiefonds, Universiteitsfonds Delft, Bouwbedrijf Fraza B.V., Bouwkundig teken- en adviesbureau Ton van der Woude, Directoraat-Generaal Rijkswaterstaat, Outokumpu Zinc, Schlumberger, Meeuwisse Nederland B.V., TNO Grondwater en Geo-energie.

News and Announcements

CHANGE OF REGISTRATION DATA

The last edition of the News Letter contained a list of the members as known to the secretariat of the Ingeokring. As can be expected with such lists, they become quickly outdated as people change address or work. We regret that this last edition lacked a proper form to have the information updated. We ask all members who want the registrated information changed to make use of the form enclosed with this edition. We would also like to ask those who may have phoned before about any changes to fill in the form and send it to the secretary of the Ingeokring (not the editors!):
Secretary Ingeokring
Ir. S.J. Plasman
PO Box 250
2260 AG Leidschendam

INTERNATIONAL SYMPOSIUM ON ENGINEERING GEOLOGY AND THE ENVIRONMENT

Athens, Greece, June 23-27, 1997.

Organized by the Greek national group of IAEG and co-sponsored by the IAH and the IUGS. Themes: 1 Engineering geology and geomorphological processes, 2 Natural and man-made hazards, 3 Geological environment in urban and regional planning and management, 4 Engineering geology and hydrology for environmental health - waste disposal, 5 Impact from the exploitation of mines and quarries, 6 Environmental aspects of the design and construction of large engineering works and schemes, 7 Protection of geological and geographical heritage, 8 Protection of historical and archaeological heritage, 9 Strategies and legislation related to geological conditions, processes and hazards affecting the environment, 10 Environmental courses in geological and geotechnical education. The symposium will be followed by excursions to sites with a geological, hydrogeological, geotechnical and environmental interest.

Official language: English, French and Greek, Papers presented in English or French. A Simultaneous translation is planned. Abstracts to be submitted before December 1995, notification of acceptance by February 28, 1996. Papers to be submitted before September 30, 1996. Preliminary registration: before December 30, 1995.

Correspondence: Hellenic Committee of Engineering Geology, Athens 1997 symposium secretariat, PO Box 19140, GR-117, 10 Athens - Greece, tel: +30-1-3813900, +30-1-2804375, +30-1-9225835, fax: +30-1-3813900, +30-1-9242570 (Prof paul G. Marinos)

ENGINEERING GEOLOGY AND WASTE DISPOSAL

The secretary of the Ingeokring received a limited amount of off-prints of the Scientific Report and Recommendations of the IAEG Commission No. 14 on Engineering Geology and Waste Disposal (in total 29 pages).

This off-print, which is included in the IAEG-Bulletin no. 51, April 1995, deals with criteria for site selection, characterization and evaluation. As this report is included in the IAEG-Bulletin and because there is only a limited amount available we feel that non-IAEG members may have some priority if they are interested in an off-print.

If you are interested, you can contact A.J. Plasman, Secretary Ingeokring, c/o Fugro Engineers, P.O. Box 250, 2260 AG Leidschendam, tel: 070-3111444, fax: 070-3203640.

THE UNESCO, DISASTER REDUCTION AND SUSTAINABLE DEVELOPMENT

The National Unesco Committee invites you for a symposium on natural disaster reduction through sustainable development. During this symposium the Unesco Coordination Programme for Disaster Reduction through Sustainable Development, which has recently been established, will be presented. Various speakers from governmental organisations, Unesco, universities are asked to present their views on this subject. Attendants of this symposium are given the opportunity to present their activities in this field through a short oral presentation during a forum discussion (several minutes) or through a poster presentation. The symposium will be held at the Ministry of Foreign Affairs in Den Haag in the Van Kleffenszaal on 15 December from 13.30 to 17.00 h. The presentations are in Dutch. Only

people who have subscribed for this symposium in writing will be admitted to the ministry of foreign affairs.

Information about this symposium can be obtained from Mrs. B.A.S. de Klerk, National Unesco Committee, Kortenaerkade 11, P.O.Box 29777, 2502 LT Den Haag, tel 070-4260266.

EXHIBITION 'HAARLEM 750 METER DIEP'

(Haarlem to a depth of 750 meters)
(September 29-October 25, 1995)
This year Haarlem celebrates its foundation of 750 years ago. As part of the festivities an exhibition on the subsurface of Haarlem was organised by the Rijks Geologische Dienst (RGD), that has its head office in Haarlem. The exhibition focused on the different types of soil and rock below Haarlem. But also the different landscapes and environments that have existed during the last 750 years were very clearly and illustratively explained.

For the occasion, the RGD has published a geological map of Haarlem and its surroundings. Also, a brochure has been produced that describes an interesting cycling route in the surroundings of Haarlem. The brochure explains the different geological units along the cycling route. Both the geological map (hfl 7.50) and the brochure with the cycling route (hfl 2,-) can be obtained at the RGD or at the tourist information in Haarlem.

RGD, Richard Holkade 10, Postbus 157,2000 AD Haarlem.
Tel: 023-5 30 03 00
E-mail: info@rgd.nl

THIRD INTERNATIONAL CONFERENCE ON THE MECHANICS OF JOINTED AND FAULTED ROCK
April 6-9, 1998, Vienna, Austria

Organized by the Institute of Mechanics, Technical University Vienna, in cooperation with OeGG/NG ISRM - Austrian Society of Geomechanics.

Special attention will be given to 3D-modelling, time-dependent behaviour, dynamic loading and complex interaction. Frame work for the conference is the step from theory to practice.

Conference themes: Geology and structural geology, Mechanics, Dynamics of jointed and faulted rock, Physical modelling and testing, Numerical modelling, Seismicity and tectonics, Instrumentation, Hydraulics, Applications. Several workshops are organised on the above fields.

Applications should be submitted as soon as possible. Extended abstracts of 500 words (minimum) in english should be submitted before May 31, 1997. Notification of acceptance is given before July 31, 1997, Final manuscript deadline: November 30, 1997.

For more information please contact:
Conference secretariat, Doz. Dr. H.P. Rossmanith, Institute of Mechanics, TU Vienna, Wiedner Hauptstrasse 8-10/325, A-1040 Vienna, Austria.
tel: 43-1-588015514 (43-222-8015514),
fax: 43-1-5875863 (43-222-5875863), email: rossmanith@emch80.una.ac.at.

Book review

Tailings and mine waste '95

Proceedings of the Second International Conference on Tailings & Mine Waste '95, Fort Collins, Colorado , USA, 17-20 January 1995. Balkema, Rotterdam, pp.131. Price: Hfl 95

This publication contains a collection of papers from the 1995 Tailings and Mine Waste conference, Fort Collins, Colorado. As with all of these type of publications, the beneficial content of this publication hinges upon the quality of the submissions to the conference. This publication is unusual in that there are no keynote papers from any of the conference organisers which include respected researchers such as John D. Nelson, Debora J. Miller or Dirk J.A. van Zyl.

There are, however, some very interesting papers covering some of the difficulties encountered in modern tailings and mine waste disposal. While many of the case studies presented are fairly typical, several contain some very fresh and new challenges for the environmental engineer. For example, a case study is presented which examines the dynamic biological processes within newly formed mining pit lakes. There is also a very good case study on the geochemical processes that occur upon interaction between existing and introduced groundwaters. Several papers demonstrate the use of modelling in the assessment of water quality. While many of these models display a high degree of sophistication and comprehensive capabilities, very few have actually been verified using field data. There is also a paper describing the use of the Analytic Element Method, a relatively new approach to ground water modelling. This approach may offer some significant advantages over traditional numerical approaches. In general the publication contents provide good case studies of design considerations related tailings and mine waste disposal. However, many other disposal aspects are not covered by this publication. In addition there are some minor typographical errors contained in it's current form which require attention. Although slightly overpriced for it's content, the book is a useful addition to the library of professionals in this area.

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Recently published papers

Most members of the Ingeokring are working in the field of Engineering Geology and related fields of expertise. By virtue of the interdisciplinary character of Engineering Geology the topics of work and study of the members of the Ingeokring range widely, and as a result their work is published in journals and proceedings of different nature. Because of this, not all publications come to the attention of the different members. To ease the access to the publications of different Ingeokring members, the authors of recently published papers are given the opportunity to present a short abstract (15 lines) of their publication, in the Newsletter. In addition the authors should give a name and address, to which persons that are interested can respond to for more information.

If you are interested one or more of these publications you can request for reprints from the authors. Name and address of the authors is listed at the end of each abstract. If you consider to submit the abstracts of your own recently publications in the next Newsletter in spring 1996, you can send your abstract with your complete name and address to the editor of the Newsletter: ir.A.R.G.van de Wall, Fac. Mijnbouwkunde en Petroleumwinning, P.O.Box 5028, 2600 GA Delft.

Site investigation surveys for dredging projects
In: Dredging '94

Site investigation surveys for the dredging industry involve pre- and post-dredging control, surveys to assess dredging levels and quantities, and surveys for pipeline trenching routes and backfill material quality.

Project design considerations will include site investigation strategies. Many site investigation techniques are currently available. Site investigation strategy seeks optimalisation and will be highly dependent on the type of project.

Well established techniques include towed geophysical instruments, Standard Penetration Tests, Vibrocoring and Cone Penetration Testing. Novel techniques include seabed based test techniques, and Geosledge test equipment. Down scaling has led to light-weight equipment which can be operated from small survey vessels.

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Foundation Investigation for the Jamuna Bridge in Bangladesh (Funderingsonderzoek voor de Jamuna brug in Bangladesh)
CT, Civiele Techniek No. 2, 1995

A Bridge over the river Jamuna is planned as a first East-West connection to develop the economy of Bangladesh. Many foundation design problems have to be solved because of the variable river width which varies between 4.5 km during the dry season and 15 km during the wet season. The foundation design was even more complex because of the presence of mica sands. It was decided to use steel tubular piles for the main bridge foundation and concrete piles for the approach viaducts.

To finalise the foundation design an extensive site investigation was performed comprising various in-situ test techniques like Cone Penetration Testing, Cone Pressuremeter Testing, Seismic Cone Penetration Testing and Standard Penetration Testing.

Because of the uncertainties of the bearing capacity of the mica sands, pile load tests were performed on reduced-scale instrumented steel piles. The piles were instrumented with tangential and axial strain gauges and the maximum axial load capacity was 20 MN. The piles were monitored during driving and during loading.

For the approach viaducts pile load tests on full scale concrete piles were performed. With the information of the pile load tests and the site investigation the foundation design could be finalised.

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Rock properties affecting the sensitivity of prediction equations for rock cutting tool wear
In: International Congress on Rock Mechanics 1995 Tokyo, Japan

The accuracy of rock cutting tool wear predictions is of ample importance for the calculation of costs and risks in the tendering stage of rock excavation projects. A sensitivity analysis applied to three different wear prediction equations showed that a small variation in rock property parameters may affect the wear prediction considerably. This holds especially for the exponential wear prediction equation. The observed high sensitivity, combined with large variations in rock properties, can be a cause of the often poor correlations between the predicted and observed rates of wear in rock cutting projects.

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The Wear Sensitive Cutting Principle of a Cutter Suction Dredger
In: Terra et Aqua no.60

The operating principle of a rock cutterhead such as used on cutter suction dredgers is an inefficient excavation process from a wear-point of view, because at each revolution of the cutterhead a pick-point has to enter the rock to make a new cut. Especially in the range of small feed, at the start of each cut, high rates of wear of the cutting tool are expected.

At least, this is shown by specially designed small scale rock cutting laboratory experiments. In these experiments high rates of wear were experienced at small penetration rates (feed) of a chisel cutting into rock.

Mechanical properties and composition of the rock to be cut determine the range of feed where the high rates of wear are taking place and they affect the level of wear in the entire cut. The relevant mechanical properties are the unconfined compressive strength (UCS) and the Brazilian tensile strength (BTS). The compositional features affecting wear are the grain size and the volume percentage of the abrasive minerals in the rock; abrasive minerals are those minerals which are harder than the tool material under the conditions (stresses and temperature) of cutting.

Considering that wear occurs mainly at the start of a cut, some recommendations can be made to improve the cutting method or to optimise the cutterhead design or the cutting process. For example by tuning operational parameters like haulage and rotation velocity of the cutterhead to the type of rock to be cut.

Besides, a better understanding of the different wear processes and the effect of properties and composition of the rock on wear provides a better basis to estimate pick-point consumption in advance of a rock dredging project.

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Review of Geotechnical Investigations Resulting from the Roermond April 13, 1992 Earthquake
In: International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics

In 1987 the Engineering Geology section at the Delft University of Technology carried out a survey of the SE Netherlands to determine which areas were susceptible to liquefaction based on soil profiles, groundwater levels and a Richter scale magnitude 6 earthquake along the principal rift fault through the Netherlands, the Peelrand fault system. The fault system has been active since the Triassic and forms part of the Rhine-North Sea rift system. The last major earthquake along the Peelrand was in 1933. Recently, in 1992, a 5.8 magnitude earthquake occurred at Roermond, near to the Dutch-German border. Through damage resulting from the earthquake was limited, remedial works to structures amounted to US$ 50 million in the Netherlands.

The paper reviews geotechnical investigations associated with the earthquake carried out in the Netherlands. Much of the damage is attributed to liquefaction; excess pore pressures resulting from earthquake caused sand vent eruptions., river dyke failures and slope failures. Comparisons are made between the predictions of 1987 and that which occurred in 1992. Site investigation works are recording geotechnical and building data so as to allow for correlations between extent of damage, ground geotechnical profiles and building design. Models for liquefaction are reviewed to describe

the slope failure as well as the sand vent phenomena. Densification of subsoil has been inferred from CPTs taken before and after the earthquake for some sites. Pile foundation damage has been investigated for buildings in Roermond for which their susceptibility to earthquake lateral forces in terms of stiffness and pile head working load is given.

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Earthquake-mail (E-mail ?) for Low-Seismic Zone Earthquake Hazard Assessment
In: Coventry FGS 31st EGAC September 1995 EGAC 95 - Geohazards and Engineering Geology, International Hazard Assessment, Mitigation and Remediation

The Roermond earthquake of april 13th 1992 in the Netherlands of magnitude 5.8 on the Richter Scale, although claiming one fatality through heart-attack, caused significant damage estimate between 30 to 40 million pound Sterling. The low recurrence determined at 135 years of earthquake of this magnitude does not encourage funding of research despite the immensity of data assembled especially in connection with damage surveys to buildings to assess compensation grants from the earthquake hazard fund set up by the Netherlands government.

Electronic mail (E-mail) is the tool made to both transfer information and to carry out mailings to both informal and solicit information. The earthquake mail facility could be integrated in a Seismological Engineering Information System (SEIS). It is being set-up to provide short links between users and suppliers of the data and analysis methods in the SEIS. An earthquake discussion box, on E-mail, concerned with problems in earthquake engineering in low-seismic countries in NW-Europe is a cautious preliminary initiative to provide a communication platform between researchers in seismology and earthquake engineering.

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Difficulties With Using Continuous Fractal Theory for Discontinuity Surfaces
In: Int.J.Rock Mech. Min. Sci. & Geomech. Abstr., Vol. 32 (1995), No.1, pp. 3-9

Roughness of discontinuities and relations between shear strength and roughness are of major interest in rock mechanics. Options to characterize roughness of a discontinuity, in terms of a fractal and/or fractal dimension, are investigated mathematically and by simulated roughness profiles. The results show that relations between the JRC roughness profiles and fractal dimension determined by the dividers method do not prove that the JRC curves are fractals, can easily be inaccurate and can lead to erroneous relations. If roughness profiles are fractals at all, then the divider method is likely not suitable for determining the fractal dimension.

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Can reflection surveys not only delineate formations but also delineate geotechnical characteristics?
In: Copenhagen XI ECSMFE June 1995

New developments in both over-water seismic reflection equipment and computer techniques have allowed for increased resolution of sediment layers and for determining the sediment characteristics such as grain size and density from the comparisons of the transmitted signal and the received signal. Modern digital signal processors (DSPs) have allowed for almost instantaneous processing of signals so that the transmitted signals can be adjusted to enhance the signal transmission. Examples of these recent developments are given from surveys carried out in the Netherlands to quantify polluted sediments and to determine sand body resources.

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Thirty year level changes in the Groningen area preceding hydro-carbon extraction.
In: FISOLS 95 The Hague

A pilot study was carried out in the Groningen gas field area of the Netherlands to differentiate the causes of settlements measured during the 30 years preceding the gas exploitation. The small changes in levels are attributed to natural phenomena such as consolidation (compaction), ground water fluctuations, salt diapirism and tectonic tilting. A study was initiated to determine the influence of these phenomena. The procedure is outlined so that first type zones are defined, settlement bench marks are chosen which represent natural movement and consolidation modelling is carried out on the more compressible top Holocene formations. Initial conclusions are that the deeper, much thicker but less compressible Tertiary formations influence the benchmark movements through consolidation except for those areas with peat deposits or situated over salt domes.

The final objective of the study will be to determine which portion of the later settlements during the hydro-carbon extraction is due to the natural phenomena pre-existing the gas field extraction.

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Investigating the sub-surface in urban areas for underground spaces with special reference to Amsterdam
In: 6th Int. Conf. Underground Space and Earth Sheltered Structures, Paris: Underground Space and Urban Planning

Investigating the subsurface in urban areas for underground spaces demands changes in approach to traditional investigation methods. More use is made of information systems to investigate, especially underneath existing buildings, not only for soil conditions but also for utilities and archaeological relics. Lack of prior knowledge of subsurface conditions can lead to costly changes in plans and even cancellation of development projects for which a recent example is given for Amsterdam. Verification of interpreted data from the information systems is required by probing and "scanning" the subsurface by penetration tests, bore holes, exploratory excavations and, increasingly, non destructive geophysical techniques.

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Stereographic projection wedge stability analyses of rock slopes using joint data
In:MJFR II Vienna

Stereographic methods for analysing the stability of jointed rock slopes is a very useful method for rapid stability evaluation in the field. This paper reviews application for measuring the stability in terms of possible failure modes: planar failure, wedge failure (for joints with the same friction angle and for joints with different friction angles) and toppling failure. The method is also used to aid the design of rock anchor and bolting to increase factors of safety and to orientate the anchors/bolts in three dimensions. Use is made of computer programmes developed in the spreadsheet environment to enable direct input in the field using inexpensive note-book type computers such as the Olivetti Quaderno. The methods are described with data derived from slope stability and rock fall analysis carried out on the Breitner Berg, on the Austrian flank of the Rhine valley.

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Assessing damage for Herkenbosch, the Netherlands, due to the Roermond earthquake of April 13, 1992
In:Soil Dynamics and Earthquake Engineering Conference VII, Crete May 1995

During the April 13 1992 Roermond earthquake the town of Herkenbosch suffered extensive damage. To examine the extent of the damage a door to door enquiry survey was carried out. 75% of the households replied to the survey, which is based on "yes" or "no" replies to questions on the residents' experience during the earthquake, the damage to their homes and other observations. The replies were entered into a database. Examples of selected replies are given to show their geographical distribution. The study requires further input data to enable more effective use of the information.

To facilitate this, the present database is structured in a way that further information can be easily added; for example reports from the *Rampenfonds* (Disaster Fund) survey, municipality information on house lay-outs and building details, and ground conditions. With sufficient data the survey should indicate which house styles or building methods are vulnerable to earthquake damage and identify those factors which influence such damage.

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Brachflächen und flächenrecycling / derelict land & land recycling
Ernst & Sohn Verlag, Berlin, 1995, pp.322.

Recycling of derelict land has become an issue of both ecological and economical relevance. Attempts to remediate contaminated sites are in line with the call for a sustainable development of our environment. Land recycling is a big market as well: in Germany for instance the government has reserved 24 billion Deutschmark for the next 10 years to subsidise land recycling projects in former East Germany alone. Land recycling is furthermore an interdisciplinary problem. This edition attempts to provide a forum for specialists from different disciplines to discuss this complex task. Key topics are land recycling and urban planning, tools and techniques of land recycling, computer aided processing and visualising, financing concepts, and management of remediation projects. A number of case histories illustrate strategies of land recycling and management concepts.

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Reaktivierung des spreebogens in Berlin / re-vitalising of the spreebogen in Berlin
In: Brachflächen und Flächenrecycling, 1995, Verlag Ernst & Sohn, Berlin , 267-279, Genske D.D. & P. Noll (ed).

Underneath the new parliament quarter in Berlin next to the Reichstag a number of tunnels for roads, the subway, and the Bundesbahn are planned. The subground of the Spreebogen, however, is more complicated as a site visit would suggest. During the second world war secret underground structures were planned as aerial photos of the allied forces revealed. These structures now obstruct the paths of the new tunnels. This article reports on the complicated task of site investigation. Historical material released recently was used to lay out an optimised site investigation strategy. Due to second world war bombs still hidden in the ground geophysical tools were combined with conventional site investigation techniques. The results unveiled that indeed underground structures were constructed and partly completed. This October Chancellor Helmut Kohl laid the foundation stone of the tunnel project that will have a budget of some 7 billion Deutschmark and shall be completed in the year 2002, if surprises from the past will not catch up with present time planning.

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Bridging the gap – engineering geology between the disciplines.
In: Jaarboek van de Mijnbouwkundige Vereeniging te Delft, 60th edition, Delft, pg. 50-58.

The inauguration speech presented at December 14, 1994, gives a perspective upon Engineering Geology at Delft University of Technology. The major task of the engineering geologist is to bridge gaps of knowledge between disciplines such as civil engineering and classical geology. With that he plays an important part to ensure cost effective planning and, even more important, to prevent geotechnical mistakes that may have far reaching consequences. Future activities will benefit notably from the successful work of the architect of the Section Engineering Geology Delft, David Price and Niek Rengers.

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A new european collaboration in the field of environmental and geo-resource engineering
In: BrachFlächenRecyling /Recycling Derelict Land, 95 (3), 57-59, Glückauf Verlag.

With a European Market growing together a common approach on training students becomes visible. Supported by ERASMUS the Universities of Cardiff, Delft, and Bordeaux are planning a European MSc.-Course in the field of Environmental and Georesource Engineering. Over a period of one year the student will be trained in England, the Netherlands, and France using English and French as teaching languages. The program aims at graduates from Universities in Europe and overseas as well as employees of consulting bureaus and administration.

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Recycling land in urban environments
In: International KfK/TNO Conference on Contaminated Soil, Maastricht, 30.10-03.11.1995

Vast areas of contaminated sites formerly used by industry have been left abandoned in European cities. Funding models to re-vitalize these sites are available under European Development Funds. Innovative tools in geotechnology and management make land recycling costs effective. Problems encountered in a major land recycling project in Europe are discussed.

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Rehabilitating mine land in urban environments: the coal mine 'minister achenbach', germany
In:Sudbury '95, Conference on Mining and the Environment, Sudbury, Ontario, May 28th - June 1, 1995.

The re-urbanisation of the derelict deep coal mine 'Minister Achenbach' in the German Ruhr District is discussed. Strategies and instruments to support a cost-effective and fast remediation and rehabilitation are pointed out. Important aspects are the correct interpretation of historical information and the results from field investigation to locate contamination and inhomogeneities in the ground. Public-private partnership is a key issue when derelict urban sites are to be recycled and appropriate funding has to be raised.

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Subsidence and wetland development in the German Ruhr-district
In: International Symposium on Land Subsidence, The Hague, The Netherlands, 16-20.10.1995.

In the German Ruhr District deep coal mining has caused considerable subsidence. The deformation of the surface has not only induced damage to buildings, it has also introduced restrictions for the future land use. A crucial point is the generation of wetlands that are unsuitable for future development. Thus, wetland generation imposes on urban planing and may therefore have far reaching economical consequences.

On the other hand, since the Ruhr District is one of the most populated regions in Europe, the land disturbed by subsidence could also offer niches for the recovery of natural habitats. A controlled development of wetlands appears to be an appealing tool to increase the diversity of flora and fauna, and to improve the quality of living in areas once known to be polluted and overcrowded. Furthermore, wetlands have an important function in cleaning certain pollutants introduced by former land use.

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Contaminant transport through fractured rocks: the state of play
In: International Congress on Rock Mechanics, September 25-30, 1995, Tokyo Japan

An attempt to inventarise research activities in the field of contaminant transport through fractured rock is made viewed from a European perspective. Recent trends and alternatives are reviewed. The problem of model verification and validation is critically discussed.

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BOOK REVIEW

Geology of deltas

Edited by Michael Oti and George Postma, A.A.Balkema, 1995, ISBN 90 5410614 X, 315 pp.

The book **Geology of Deltas** has as objective to offer the advanced geology students a general idea on the advances in the different aspects of delta studies. The book is subdivided in four parts:
part 1: dealing with delta classification and the basic variables controlling delta growth.
part 2: treating delta evolution through time and space.
part 3: treating new statistical and geochemical methods as applied to sedimentary petrology and diagenesis.
part 4: is focussing on the Niger Delta and in particular on the aspects related to the oil exploration and exploitation, as well as the impact of this on the actual geodynamic processes acting on the Niger Delta.

The first part starts with an excellent review of the variables governing delta growth and development. A classification for deltas is given in function of fluvial regime, basinal conditions (wave and tidal influences) and the gravitational reworking. Tectonic and climatic variations are factors influencing the development in time.

In the following article a correlation is made between the theoretical sedimentological models and seismic reflection, with the objective to come to seismic models for different delta systems. It is a pity that in this most interesting article the added value of 3-D seismics is not highlighted.

The very extensive description of the most complex systems of suspended sediment plumes, which are discussed in detail for all types of environments, is a little in unbalance with the other contributions in this part.

The part dealing with facies and architecture of deltas, starts with a very clear article on the development of the Jurassic Brent Delta in the Viking Graben in the Northern part of the North Sea. The article gives an excellent description of the spatial interpretation of a large amount of detailed sedimentary data. The spatial correlation of these data is supported by palynological analysis of the sedimentary data.

This article is followed by the palaeogeographic reconstruction of the Carboniferous/Permian Northern Hubei Basin, which covers an area of more than 200.000 square kilometres in Central-east China. The analysis is based on the interpretation of 10 stratigraphic section and about 500 boreholes. Interpretation of the stratigraphic sequences show several delta complexes, each consisting of a number genetically linked delta systems, which can be followed over the whole basin. The major architextural facies elements are discussed and the relative sea level change in time is reconstructed.

In a similar study, presented by Bamberry et al., a sedimentological model for the Permian Illawarra Coal Measures in the southern Sydney Basin is developed. Also this paper gives a detailed litho-stratigraphical analysis over a large area, based on the interpretation of 30 measured outcrop sections and about 600 cores of boreholes.

On the other hand Jacobs presents a model for the Eocene/Oligocene sedimentation in front of the Belgian coast, based on the interpretation of the cores of only four wells. According to this author, the sequence is a classic example of a shallow marine silica-clastic delta and a reconstruction of the relative sea-level change is made.

The last article in this part presents the stratigraphy and sedimentary framework of the deep water Holocene Fraser Delta between British Columbia and Vancouver Island. The reconstruction of the delta is based on airgun seismic records, locally supported by sonar tracklines. In the delta front coarse sediments are traced, representing debris flows and turbidites. However, failure deposits broader than the river mouth associations cannot genetically explained. Their geotechnical implication in relation with harbour works should be investigated.

The third part of the book deals with a number of specific specialistic topics regarding sedimentary petrology and diagenesis. Weltjes discusses in an interesting article the validity of statistical provenance models, as developed by Dickinson a.o., on the basis of a detailed mineralogical

analysis of sediment samples obtained from the Po Delta and the adjacent beaches of the Adriatic Sea.

Kalmar discusses the very recent marsh deposits from the Danube Delta. The author shows how certain clay minerals are sensitive for diagenetic changes and he mentions indications for geochemical pollution of the highest horizons with heavy metals, as a result of the industrialization along the banks of the Danube.

The former subject, dealing with the reaction of clays in the diagenetic process, is continued by an article highlighting the thermodynamic aspects of the changes in clays during diagenesis. Aja discusses the controls on illitization reactions. He gives the analysis of P-T phase diagrams for illitization, finding basically a dependency of temperature.

The last part of the book is entirely dedicated to studies on the Niger Delta. The part of the book initiates with an analysis of the ancient (Cretaceous) Niger Delta. Petters gives an analysis of the sedimentation, restricted to the Benue Trough, on the basis of the foraminiferal biofacies in comparison to the foraminiferal composition of the actual continental margin Niger Delta. Particularly the prodeltaic facies, clearly represented in the actual delta, is missing in the ancient one, indicating the different palaeo-ecological environment.

Beka and Oti are demonstrating the positive prospects for oil exploration of the distal Niger Delta. They identify the marine Akata Shale Formation as possible source rock. The structural deformation of these shales has created large fault bounded depressions. The sedimentary fills of these depressions are, in analogy to certain productive areas, identified as possible traps for the hydrocarbons, migrating from the overpressured shales of the Akata Formation.

Oboh presents an article on the sedimentological and palynological characterization of the E2.0 Reservoir sediments of the Kolo Creek field. Five sandstones, three heteroliths and two mudstones were identified in the two cores of 50 m. each. The analysis of the lithofacies defines the sandstones as quartz arenites and subarkoses. The mudstones contain 60-90% of clay, particularly kaolinitic and in lesser amounts of illite/smectite and illite. The palynological interpretation shows two palynofacies associations. Dominant species are two mangrove species and Graminidite grass pollen. The sedimentary sequence is dated as lowermost Middle Miocene and the occurrence of the grasspollen are an indication for slightly drier climatic conditions.

The complex constitution of the hydrocarbon reservoirs and their relation to possible source rocks is discussed in a short but clear article by Stacher. The distribution of the oilfields is mainly controlled by synsedimentary growth faults, resulting in stratigraphic traps and structural traps, related to rollover anticlines and fault controlled structures. The analysis of the oil are indicating a source rock rich in debris of land plant, while the structureless organic matter indicates marine source rocks. The analysis of the potential source rocks are found to be immature and therefore they are not associated with the hydrocarbons. Based on these findings the author concludes that prodelta shales rich in land derived organic matter at greater depth (9000- 11000 ft.) are likely to be the source rocks.

Nwangwu discusses a unique stratigraphic trap. The genesis is thought to be related with a fast rate of uplifting due to differential loading and resulting in a barrier and a sand depocentre on the continental side against an anthithetic fault.

The following article enters on the analysis of authigenic clays in the reservoir rocks of the Agbada Formation. The authigenic differentiation of clay minerals (mainly kaolinite) in hydrocarbon bearing sandstones is remarkably different to the water bearing sandstones, having a considerable higher percentage of smectite and illite. This is interpreted as caused by early generation, migration and emplacement of the oil. Large volumes of water released from the source rocks aided the oil migration.

The geochemical analysis of a large number of oilcrude samples allow for a classification of the oils in two groups. Due to different sources in the sediment supply, the oils from the Oligocene have the highest metal ratios. As observed in the article of Stacher, the V and Ni ratios are found to be low, as well as the sulphur content, indicating a derivation of oils largely from terrestrial matter. Cross plots of the metal ratios are showing that oils belonging to one group are biodegradated equivalents of the hydrocarbons of the other group.

In an article on the possible environmental impact of the oilexploration in the Niger Delta, the tolerance of the Nitrobacter sp. to six Nigerian oil crudes was investigated.

It was found that the Nitrobacter exhibits a high tolerance to Nigerian crudes, while the enzyme biosynthesis assays represents, in comparison to

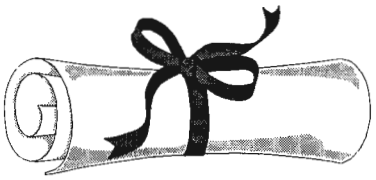
EC50 and LC50 experiments, the best method to assess the toxicity of crude oil to the Nitrobacter.

The last article by Oyegun is giving the results of a study on the erosion and sedimentation rates along the coast of the delta and makes a correlation between these processes and the oil exploitation. Coastal erosion on places were sedimentation existed, are caused by the interruption of the longshore drift by pipeline constructions to offshore sites. Those findings are sustained by other investigations along the Nigerian coast, where artificial structures obstruct the flow of litoral drift materials.

On the whole this book contains a large number of most interesting and well written articles, covering a very wide field of topics related to the geology of deltas in the widest sense. This gives automatically also the weak side of the book. A specialist will find only a limited number of article which will have his personal interest. This number will be relatively high for geologists working in the oil exploration or certain sedimentologists, it is low for specialists in engineering geology, the target group of this journal. Considering this point and taking into account the price of the book (200 guilders), I have my doubts if the book will reach directly the group of advanced geology students for whom it is edited in the first place. However, I can recommend these students to get it on loan from their library, because the content gives a very good idea of the different approaches in modern delta studies.

R. Soeters,
I.T.C. Eschede

The Netherlands Students Award for Engineering Geology



The Ingenieursgeologische Kring, the Netherlands National Group of the International Association of Engineering Geology (IAEG) has established a prize for the best ir., drs. or MSc thesis in the field of Engineering Geology submitted to a Netherlands institute of higher education. The prize is a sum of NLG 1,000 and a certificate, to be handed out at the annual meeting of the Ingeokring in the spring of 1996. The thesis must be a contribution to the application of earth scientific knowledge to the solution of problems in civil engineering, mining engineering or environmental engineering.

We invite the submission of theses produced in the academic year September 1994-August 1995.

Individuals can send in their own thesis or the thesis of others. Membership of the Ingenieursgeologische Kring is not required. Three complete copies of the thesis (including figures, photographs, annexes) have to be submitted by December 15, 1995 to the secretary of the Ingeokring. The committee which will select the best thesis is composed as follows:

* Drs H.R.G.K. Hack (chairman Ingeokring)
* Prof.Dr D. Genske (TU Delft, chair Engineering Geology)
* Dr J. Rupke (Universiteit van Amsterdam, Dept of Physical Geography)
* Ir A.H. Nooy van der Kolff (Boskalis Westminister BV)
* Ir C.M. Breukink (IWACO)

Criteria used for the selection will be:

* relevance for earth sciences and engineering
* scientific quality
* originality of approach
* quality of presentation

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* Geocom Consultants

The Netherlands National Group of the International Association of Engineering Geology (IAEG), the "Ingeokring" founded in 1974, is now the largest section of the KNGMG, the Royal Geological and Mining Society of the Netherlands. With more than 200 members working in different organisations, ranging from universities and research institutes to contractors, from consultancy bureaus to various governmental organisations, the Ingeokring is playing a vital role in the communication between engineering geologists in the Netherlands.