Ingenieurs Geologische Kring
Netherlands Section of Engineering Geology
Secretaris: Dr. J.J.A. Hartevelt
Postbus 63, 2260 AB Leidschendam (the Netherlands)
Postgiro: 3342108, t.n.v. Penningmeester Ingeokring Delft.

INGEOKRING NIEUWSBRIEF

december 1987

NIEUWSBRIEF INGEOKRING

december 1987

. Inhoud: pag.

Nieuwsbrief van de Ingenieursgeologische Kring
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Van het bestuur............

Voor u ligt het laatste nummer, jaargang 1987, van onze Nieuwsbrief.
In de laatste tijd is hij niet regelmatig verschenen. Dat lag niet aan het enthousiasme van de redactie. De voornaamste reden voor het slechts een of tweemaal verschijnen is het gebrek aan financiële middelen dat veroorzaakt wordt door het niet of niet tijdig betalen van de contributie door een vrij groot aantal leden. Uzelf hoort hier natuurlijk niet bij !
Bij de aanstaande overgang naar een nieuw jaar wil ik dan ook alle leden van de Ingeokring oproepen niet te lang te wachten met het voldoen van de bijdragen voor het lidmaatschap van de Kring. En diegenen die vergeten zijn over het afgelopen jaar of jaren te betalen, nogmaals te verzoeken hun vergissing zo snel mogelijk goed te maken.

Als u deze Nieuwsbrief doorbladert zult u zien dat het in het afgelopen jaar niet ontbroken heeft aan interessante activiteiten. Voor het komende jaar staan eveneens activiteiten op het programma , die van belang kunnen zijn voor een brede kring van personen op een of andere manier betrokken bij het uitgebreide vakgebied van de ingenieursgeologie.
Met name wil ik hier noemen het jaarlijkse symposium, wat deze keer gehouden zal worden rong het thema: "Het Milieu en de Aardwetenschappen", of zo u wilt: "Environment and Earthtechnology".
De betrokkenheid van een groot aantal ingenieursgeologen in dienst bij overheid, bedrijfsleven en opleidingsinstituten bij het realiseren van een pilotstudie voor het tot stand brengen van aangepaste ingenieurgeologische kaarten. Waarbij voor deze pilotstudie de keus is gevallen op enkele gebieden binnen de Amsterdamse gemeentegrenzen omdat de uitgebreide gegevensbestanden van Amsterdam voor deze studie ter beschikking gesteld werden. De voorlopige resultaten geven uitzicht op reeele mogelijkheden om voor een aantrekkelijke prijs in te spelen op specifieke behoeften van gemeentelijke overheden aan een beheersbare planning va stadsuitbreiding, vernieuwing of renovatie van bijvoorbeeld rioleringsystem, enz.
Op de behoeften van projectontwikkelaars aan gedetailleerde informatie over bodemverontreinigingen en funderingsmethoden voor een juiste inschatting van mogelijke problemen verbonden aan een anderszins aantrekkelijke bouwplaats.
In het algemeen is hiermee in principe een systeem gecreeerd waarmee ingespeeld kan worden op de behoefte van iedere instantie of organisatie die beter geinformeerd wil zijn over de effecten van ingrepen in onze bodem, of dat nu een waterkering in de Nieuwe Waterweg is, de opslag van chemisch en radioactief afval, of de effecten van PCB's en nitraten op de drinkwaterhuishouding.

Ook zal het komende jaar een verhoogde activiteit te zien geven in de organisatie van het zesde internationale I.A.E.G. congres en tentoonstelling, wat in principe door de Ingenieurgeologische Kring, als nationale vertegenwoordiger van de I.A.E.G., georganiseerd zal worden.
Een werkelijk internationale bijeenkomst, eens in de vier jaar, telkens op een ander continent gehouden, in 1990 in Nederland in Amsterdam. Uitwisseling van de laatste ontwikkelingen op het gebied van de engineering geology en de xport van de Nederlandse kennis en kunde op dit gebied zullen dan centraal staan. Hierbij worden personen bereikt die direct bijdragen aan de beleidsvorming op de gehele wereld of beslissen over toepasing van methoden en systemen.

Verder ligt het in onze bedoeling om de Nieuwsbrief eenmaal per kwartaal te laten verschijnen. De volgende Nieuwsbrief kunt u dus in maart 1988 verwachten. Hierbij zal de inhoud kwalitatief op een internationale standaard gehouden worden en voor het gebied interessante informatie aan de toets van actualiteit moeten voldoen. Gemotiveerde studentenleden van de Kring, verenigt in DIG (Dispuut IngenieursGeologie), staan garant voor een optimale verwezenlijking van deze ideeen.

Op deze plaats een vriendelijk verzoek aan alle leden van de Kring, die uit hoofde van hun functie benaderd worden om iddeels een advertentie te helpen een hoogstaand periodiek in stand te houden. Promotie van en steun voor deze actie zal door ons zeer gewaardeerd worden.
Echter ondanks deze steun uit het bedrijfsleven zal het mogelijk toch noodzakelijk blijken om het komende jaar de lidmaatschapsbijdrage voor de Kring te verhogen. Een verdubbeling vam de bijdragen voor alle leden moet dan de financien genereren om u regelmatig op de hoogte te kunnen houden van de laatste ontwikkelingen. Een en ander is evenwel duidelijk afhankelijk van de hoogte van de donnaties door instituten en bedrijfsleven.
Geheel "au fonds perdu" zullen deze donnaties echter niet zijn. Zij stellen ons in staat activiteiten te organiseren voor een bredere groep belangstellenden en om een Nieuwsbrief te laten verschijnen die voldoet aan de de moderne eisen en een inhoud te bieden heeft van belang voor een groot aantal vakgebieden en niet alleen op nationaal niveau.
Het bovenstaande laat zich heel pragmatisch vertalen in een aantal aanbevelingen. Op de eerste plaats is het in uw eigen belang om collega's en belangstelenden over te halen om lid te worden van de Ingeokring.
Steun van het bedrijfsleven wordt gehonoreerd met up-to-date informatie en probleemoplossende artikelen over het gehele werkingsgebied van de ingenieursgeologie. Deel uitmaken en kennis nemen van de snelle ontwikkelingen op een modern vakgebied komt ten goede aan het beleid, werkt probleemoplossend en kan de concurrentiepositie verbeteren.

Mij rest nog u te bedanken voor uw steun in de afgelopen jaren en u toe te wensen een interessant, voldoeninggevend en ingenieurgeologisch profijtelijk 1988.

J.E. Hageman
Voorzitter.

Ingenieurs- Geologische Kring
Netherlands Section of Engineering Geology
Secretaris: Drs. R.Haakmeester
Postbus 264, 6800 AG Arnhem (The Netherlands)
Postgiro 3342108 t.n.v. Penningmeester Ingeokring, Assen

INGENIEURS-GEOLOGISCHE KRING — Jaarverslag 1986

Bestuur

In 1986 was het bestuur als volgt samengesteld:

Dr. E. Oele	- Voorzitter/Vertegenwoordiger I.A.E.G.
Drs. R. Haakmeester	- Secretaris
Ir. J.G. Bakker	- Penningmeester
Drs. J.E. Hageman	
Prof.Ir. H.P.S. van Lohuizen	
Prof. D.G. Price	
Dr. N. Rengers	- Vertegenwoordiger ISRM
Drs. P.N.W. Verhoef	- Redacteur Nieuwsbrief

Het bestuur vergaderde met een frequentie van ca. 1 maal per twee maanden. Omdat de geplande organisatie van het IAEG 1990 congres in Amsterdam in de loop van 1986 steeds meer tijd vergde en een specifieke organisatie en overleg structuur nodig bleek is eind 1985 de Stichting IAEG 1990 opgericht. Het bestuur van deze stichting bestond aanvankelijk uit de heren Oele, Haakmeester en Bakker in de respectievelijke functies van voorzitter, secretaris en penningmeester. In april 1986 is dhr. H. Beijer tot de stichting toegetreden in de functie van Secretary General bij de organisatie van het congres. Het bestuur van de Stichting IAEG 1990 heeft een afzonderlijke vergaderagenda. In 1986 heeft het bestuur een actie plan opgesteld dat voorziet in een bestuurswisseling in de loop van 1987 waarbij de huidige secretaris respectievelijk de voorzitter zullen aftreden volgens de statuten van de Kring.
De jaarvergadering van de Kring vond plaats op 10 april en is door 15 leden bijgewoond.

Lezingen en excursies

In 1986 zijn de volgende lezingen en excursies georganiseerd:

15 januari : Een themadag over geologische opberging van radioactief afval met voordrachten van deelnemers van het OPLA (opberging te land) project trok ruim 120 belangstellenden. Lezingen zijn gehouden door Ir. B.P. Hageman (voorzitter Cie. OPLA; RGD), Ir. R.M. Korthof (EZ), Drs. L. v.d. Vate (EZ), Ir. P. Glasbergen (RIVM), Dr. H.M. van Montfrans (RGD), Ir. T. de Boer/Ir. L.H. Vons (ECN), Ir. J.J.E. Pöttgens (Staatstoezicht op de Mijnen), Prof.Dr. H. Zwart (RUU) en Ir. J. Prij (ECN).

10 april : Lezing door Ir. H. den Rooyen (LGM) over geotechnisch onderzoek in de Baai van Maracaibo (Venezuela). Ca 25 belangstellenden woonden de lezing bij.

12 mei : In samenwerking met CEDA (Central European Dredging Association) lezingen georganiseerd met als thema de slijtage van baggerwerktuigen door gesteente. Sprekers waren Ir. J.N. Korver (Boskalis) en Drs. P.N.W. Verhoef (TUD). Er waren ca. 75 toehoorders.

25 september : Als vervolg op de lezingen op 12 mei in samenwerking met CEDA werd vanuit de Kring een bijdrage geleverd door Prof. D.G. Price, 'Classification of rock masses for dredging'.

12 november : Themadag over geologische en hydrologische aspecten van de verbreding van de Zuid-Willemsvaart. Lezingen zijn gehouden door Ing. A. Steketen (RWS), Ir. E.M.E. Rooijen (RWS) en Ing. F.D. de Lang (RGD). 's-Middags was er een excursie in de omgeving van de Zuid-Willemsvaart waarbij diverse geologische afzettingen werden getoond en een demonstratie werd gegeven met elektromagnetische meet-apparatuur. Ca. 15 belangstellenden woonden de themadag bij.

Namens de Ingeokring heeft Drs. J.E. Hageman medewerking bij de organisatie van een symposium over ondergrondse ruimten en infrastructuur. De feitelijke organisatie van dit op 26 en 27 november gehouden symposium berustte bij KIVI, NIDIG en NVA leden.

Leden

Het ledental van de Kring bedroeg per 31 december 1986 154 leden waarvan en 71 eveneens lid zijn van de IAEG en 18 eveneens lid zijn van ISRM. In totaal zijn 26 studenten lid van de Kring. Ook in 1986 zijn er ca. 20 leden die een of enkele jaren achter lopen met de contributie.

Nieuwsbrief

De Nieuwsbrief is eenmaal verschenen en wel in juni.

Kas

Zie verslag Kascommissie.

Jaarverslag Ingeokring 1986

Ontvangsten		Uitgaven	
Kring 1984	f 15,--	Excursie Antwerpen	f 89,60
Kring 1985	f 90,--	Themadag OPLA	f 1.436,25
Kring 1986	f 1.785,--	Lezing geofysica	f 69,75
idem studenten	f 140,--	Lezing classificaten	f 50,--
Kring 1987	f 20,--	Nieuwsbrief 1985	f 132,--
IAEG 1985	f 50,--	Nieuwsbrief 1986	f 527,52
IAEG 1986	f 1.550,--	Contributies IAEG	f 1.568,36
IAEG 1987	f 32,50	Contributies ISRM	f 465,--
ISRM 1986	f 540,--	Lening Stichting IAEG 1990	f 665,--
ISRM 1987	f 32,50	Subsidie IGSK	f 225,--
Instellingen 1986	f 110,--	Representatie	f 259,80
Themadag OPLA	f 1.260,--	Administratie	f 19,95
Excursie Antwerpen	f 40,--	Porti	f 185,70
Themadag georadar	f 928,--	Saldo giro	f 962,18
Themadag zoutkoepels	f 32,25		
Rente giro	f 30,36		
Totaal	f 6.656,11	Totaal	f 6.656,11

Opgesteld: 1987-04-07

Geverifieerd door:

R. Hillen

A. Nooij v.d. Kolff

Begroting Ingeokring 1987

Inkomsten

Contributie Kring	
gewone leden	f 3.000,--
studenten	f 150,--
Contributie IAEG	f 1.600,--*)
Contributie ISRM	f 500,--*)
Donatie	f 100,--
Totaal	f 5.350,--

Uitgaven

Contributie IAEG	f 1.600,--*)
Contributie ISRM	f 500,--*)
Kosten sprekers	f 500,--
Kosten excursies	f 250,--
Kosten themadagen	f 250,--
Nieuwsbrief	f 600,--
Congres IAEG 1990	f 2.500,--
Administratie en porti	f 200,--
Representatie	f 150,--
Totaal	f 6.550,--

Opgesteld: 1987-04-07

Voorstel contributie Kring:	gewone leden	f 20,--
	studenten	f 10,--
	IAEG	f 32,50*)
	ISRM	f 32,50*)

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*) voorlopige opgave

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THE ENGINEERING GROUP OF THE GEOLOGICAL SOCIETY

CALL FOR PAPERS

24th Annual Conference 4th to 9th September, 1988

SUNDERLAND POLYTECHNIC

FIELD TESTING IN ENGINEERING GEOLOGY

The Conference will consider and discuss the role, usage, performance and viability of in-situ tests. Papers are sought which will introduce new methods and further the practice and understanding of established techniques. The emphasis is on case histories which demonstrate the effectiveness or otherwise of field esting in accurately predicting performance.

Papers should address the following themes:

STRENGTH
DEFORMABILITY
GROUND WATER FLOW AND PRESSURE
GEOPHYSICALLY DETERMINED PROPERTIES

in relation to

SOILS and SEDIMENTS — WEAK and WEATHERED ROCK — STRONG ROCK

Long term monitoring, measurement and instrumentation will not be covered

WORKING SESSIONS — FIELD EXCURSIONS — TRADE EXHIBITION — PUBLISHED PROCEEDINGS

Abstracts of not more than 300 words to Dr. F. G. Bell, Engineering Group, Geological Society, Burlington House, Piccadilly, London, as soon as possible but not later than 30th November, 1987

CONFERENCES, SEMINARS and SYMPOSIA in 1988

12 january	Rock mechanics in highway engineering. Geological society, Burlington House, Piccadily, London W1V, OJU.
19-22 january	Tunnelling for water resources and power projects. New Delhi, India. Shri C.V.J. Varma, member secretary, central board of irrigation and power, Malcha Marg, Chanakyapuri, New delhi-110021.
3 february	Recent advances in rock materials. Geological society, Burlington House,Piccadily, London W1V, OJU.
8 march	Tropical residual soils (working party report). Geological society, Burlington House, Piccadily, London W1V, OJU.
11-15 april	6th International conference on numerical methods in geomechanics. Innsbruck, Austria. Kongresshaus Innsbruck, ICONOMIG 88, Rennweg 3, A-6020, Innsbruck, Austria.
18-21 april	Tunnelling 88, fifth international symposium, London, England. The conference office, institution of mining and metallurgy, 44 Portland place, London W1N, 4BR, England.
23-24 april	Field weekend: dams in north country/pennines. Geological society, burlington House, Piccadily, London W1V, OJU, England.
25-27 april	Centrifuge 88. Paris, France. French committee for soil mechanics, Mr. Jean-Francois Corte, LCPC, B.P. 19, F-44340 Bougenais, France.
27-29 april	8th National rock mechanics symposium. Aachen, FRG. DGEG, Kronprinzenstr. 35a, D-4300 Essen 1, FRG.
17 may	Engineering geology and groundwater in land reclamation. Geological society, Burlington House, Piccadily, London W1V, OJU.
1-3 june	2nd International conference on case histories in geotechnical engineering. St. Louis, USA. (Civil engineering dept. univ. of Missouri-Rolla, Rolla M.O. 65401-0249, USA.
june	Tunnels and water. Madrid , Spain. Association espagnola de tuneles y obras subterraneas (AETOS) Calle Martines Izquierdo, 53, 2, 3, E-28028, Madrid, Spain.
13-15 june	16th Congress of the ICOLD. San Fransisco, USA. ICOLD 88, Mr. H.L. Blohm secrtary, Bechtel Civil

P.O. Box 3965, San Fransisco CA 94119, USA.

13-15 june	Key questions in rock mechanics. Minneapolis, USA. Dr. Raymond L.Sterling, Univ. of Minnesota, dept. of civil and mineral engineering, 500 Pillsbury drive S.E. Minneapolis, USA.
10-15 july	5th International symposium on landslides. Lausane, Switzerland. Mr. Christophe Bonnard, Secretariat du 5eme symposium international sur les glissement de terrain, case postale 83, CH 1015 Lausanne 15, Switzerland.
22-26 august	5th Australia-New zealand conference on geomechanics. Sydney, Australia. Mr. Michal J. Thom, c/o Douglas & Partners ltd, 322 Victoria road, Rydalmere, NSW 2116, Australia.
11-15 septemb.	24th Annual conference, field testing in engineering geology. Sunderland Polytechnic. Geological society, Burlington House, Piccadily, London, W1V, OJU.
12-16 septemb.	Rock mechanics and power plants. Madrid, Spain. Sociedad Espagnola de mecanica de las rocas, Paseo bajo de la virgen del puerto, 3, E-28005 Madrid, Spain.
19-23 septemb.	Engineering Geology as related to the study, preservation and protection of ancient works, monuments and historical sites. Athens, Greece. Greek committee of engineering geology, 1988 symposium secretariat, P.O. Box 19140, GR-11710 Athens, Greece.

First announcement of the engineering geological symposium 1988.

Because of the succes of the symposium in february 1987, the board of the Dispute Engineering Geology has decided to make it an annual event. This year (i.e. 1988) the title of the symposium is "Environment and Earthtechnology". The precise date has not been fixed yet, but it will be in the end of april 1988.

The plan of the symposium will be approximately as follows:

8.00	Arrival and registration
9.00 - 10.30	First session beginning with a speech of welcome
B R E A K	
11.30 - 12.45	Second session
L U N C H	
14.00 - 15.15	Third session
B R E A K	
15.45 - 16.30	Fourth session, being a forum discussion.

Per session (1 till 3) probably four or five speakers will be placed. Each of these speakers will have 10 till 15 minutes with 5 minutes extra time just in case. The sessions receive as titles:

1 Geological storage
2 Surfacewater and groundwater
3 Mining, polluting or cleaning industry ?

Between the sessions there will be an opportunity to visit the poster-presentations, where some (additional) information can be got. After each session an opportunity is given for questioning. When the question is very specific, the questioner will be consigned to the poster-presentation of the speaker in question.

The fourth session will be a forum discussion. It is the purpose to form a forum of some of the speakers and experts, who will discuss some statements and, in case of questions or remarks from the public, will come to an open discussion with the public. This fourth session will be an open one, i.e. entering and leaving will be allowed at any time. At the end of the forum discussion a concluding drink will be held, so that arised quarrels can be settled and the last moments of the symposium will be a succes anyhow.

R. Vreugdenhil Secretary

REPORT ON ENGINEERING GEOLOGY CONFERENCE:

Engineering Geology of Underground Movements

by P.M. Maurenbrecher, TU Delft

The conference

"Underground movements" for 1987 one immediately thinks of either Ekofisk or Groningen. Neither of these two newsworthy subjects were discussed this year at the conference held at Nottingham University under the title of Engineering Geology of Underground Movements. The conference forms part of the Engineering Group of the Geological Society's (London) annual regional meetings similar to that reported in IngeoKring Nieuwsbrief of April 1987 on "Planning and Engineering Geology" which was held at Plymouth Polytechnic.

The contents of the conference were certainly newsworthy despite the demise of Ekofisk and Groningen; the Engineering Geology Section at Mijnbouwkunde, Delft ensured more local newsworthy items by presenting at this conference a paper on mining instability from the disused limestone mines of South Limburg (Price and Verhoef, 1987). Such a presentation came at an opportune moment as collapse with loss of life had occurred on 19th June, 1987 during the construction of a new access tunnel in the limestone at Casino Slavante, St. Pietersberg, Maastricht

The conference lasted from 13th to 17th September, 1987. The first, third and fourth days involved presentation of papers in a total of ten sessions. During this time an exhibition consisting of stands of engineering geology orientated firms and institutions could be viewed during coffee and tea breaks. The days continued well into the evenings consisting social gatherings such as a reception given for the occassion by the Lord Mayor of Nottingham at the City Hall, a wine party at the trade exhibition, and a conference dinner with witty speeches and toasts. The second day the delegates could choose from a number of field trips. Coal Mines, the British Geological Survey, Fluorite Mines, Gypsum mines or the Pre Cambrian of Charnwood Forest could be visited.

Subsidence of the Earth Sciences in the U.K.?

The sessions were preceded by the opening and welcome given by the chairman of the Engineering Group, Dr. R.K. Taylor emphasized in his opening statement that ground movements can result in dramatic subsidence though the more frequent and more numerous smaller movements are those which cause the most financial losses.

Dr. B.C.L. Weedon, Vice Chancellor of Nottingham University gave the welcome address and plunged straight into the plight wrought by cost (but not value) concious politicians of the eighties on the earth sciences at British academic institutions. The Oxborough report heralds the era of Centres of Excellence (American imports have not only permeated Wagner reports in the Netherlands but also Oxborough reports in the United Kingdom) in both cases saying, in effect, the earth sciences are fundamental to the countries' economic well-being but that they (the governemnts) would like it on the cheap ie lots of return on minimal investment; this can be done, the reports say by reorganizing the earth science education into Centres of Excellence. These Centres are *allowed* to do research whereas

continued next page

those academic institutions not so designated can only, at most, teach. That in the past centres of excellence came and went as a result of healthy competition between academic institutions apparantly does not receive consideration despite the British (and Dutch) governments being exponents of free enterprise.

Sessions of Ground Movements

These were not earthquakes set off by applauding earth-scientists in the Nottingham area in the wake of Dr. Weedon's address but up to ten themes involving aspects of ground movement:

Introduction
Tunnelling
Deep Excavation
Construction Operations
Abandoned Mine Workings
Long Wall Mining
Abandoned Limestone Mines in the West Midlands
Investigation
Abstraction or Injection of Fluids
Seismicity

1: Introduction

Regional Geological delights

Introductions were made by Dr. Lovell who described the geology of the Nottingham area. The half hour allowed him was insufficient to describe the almost complete geological table being represented by strata in the area from Pre-Cambrian diorites of Charnwood forest to the recent river terraces of the River Trent that passes through Nottingham. Of note is that the excellent local beers obtain their water from the Permian sandstone aquifers. Besides beers and the local hero, Robin Hood, (no geological formation called after him but there is a Sherwood Sandstone, which makes a good roadstone) the area appears to be almost totally dependent on the geology; coal, millstone grits (for making milling stones), oil, fluorite, gypsum (one-third the U.K. supply), silica sands, gravels, and more fuels: lignites.

Ground movements only a matter of time

Professor Geddes from the Department of Civil Engineering and Building, University of Wales Institute of Technology introduced the subject of ground movement. He used time to describe both the causes of movements and processes of movements:

Causes were from

- the present: long wall mining, tunnelling, deep excavations,
- the past: abandoned coal/ limestone mines,
- the past, present and future: injection and abstraction of fluids.

continued next page

Processes were

primary time response
long term: creep
erosion/ solubility
progressive processes.

To investgate movements the civil eneginеer said, "Geological experience greatest value". Music to the ears of the engineering geologists present
Such investigation should produce data to enable safety, economics, and when does movement manifest itself with respect to civil engineering and building structures . This requires knowledge of material properties (anywhere from elastic to viscous), discontinuities, time element and stress changes.

Excavation such as long wall can mining cause initially horizontal then vertical associated with extended (tensile) and compressed movement.

Important to design the structure so as to match the movement. Conversely movement of ground will induce similar movement in the building structure.

Engineer should resolve:

a. avoidance < Remove cause / Recognise movement, monitor >planning or hazard map, serilization

b. Ground treatment; chemical treatment, grouting

c. Modify method of working, furnish* deep excavation techniques

d. Structural methods: reinforcement/ temporary supports

Having introduced concepts of movement and the options for minimising the distress a final geological note was sounded: Remember movement is 3 dimesional.

Session 2. Tunnelling:

The tunnelling sessions considered prediction methods for subsidence using both empirical and numerical methods in soft ground. Three papers were presented on this theme, of which one was purely theoretical, the next compared predictions with that monitored (good comparisons) and the third classified case histories of tunnels performance producing empirical correlations. To predict the effects on surface structures was more difficult and bares out the introductory speaker's remarks that risk analyses appears to be more relevant. He gave an example of the costs for the Taipei metro tunnels rising from 1 to 5 billion pounds as a result of the tunnelling affecting surface structures.

Case histories were given by two speakers, one concerning meeting the unexpected: a burried channel and how this was tunnelled using freezing techniques. The second was given by Dr. Bill Ward, for tunnels in rock showing the negative effects of rock stresses for `half tunnels' in the Himalayas and high water pressures can cause bursts in schistose rock for a tunnel in the Congo (Brazzaville)

continued next page

Session 3: Deep excavations:

This session covered an introduction by Professor Atkinson and three diverse case histories. Professor Atkinson mentioned the use of the centrifugal test to model excavations retained by cantilevered sheet pile loads. They indicate the Rankine active modes behind the wall.

The case histories concerned deep excavations due to bored piling, retention wall for a road cutting and a power station cavern.

.the effects of large bored piling causing soil loss at the base and the preservation of a historical faČade despite substantial displacements

.well monitored behaviour of construction of a temporary pile sheet anchored retention wall followed by unloading after contructing a permanent concrete retention wall infront and backfilling.

.Underground chamber for power station for the Tana River Scheme, Kenya showed that predictions using boundary element stress analyses compared favourably with field measurements; the small magnitude of the movements cast some doubts as to the sensitivity of the measurements.

Session 4. Construction:

Four presentations, of which three were case histories on structures associated with limestone mines, sinkholes and longwall mining. The fourth presentation was a research paper by Prof. D. Muir Wood on centrifugal model testing of soil deformation by a inward movement of basement roof. Clays could be simulated as they are less affected by scaling factors and gave normal rupture faulting at the surface.

The case histories were:

.Grouting of sinkholes in dolomites prior to dewatering by goldmining in South Africa, where grouting itself caused erosion of superficial deposits causing collapse to take place.

.Cost benifit design aspects of a proposed water tank reservoir over old limestone mines in Bath. Though rel-location was eventually granted by planning authority (the cheapest option), initially this option was not sure so infilling cavity, rock dowels, span beams and column reinforcement were the options that were considered.

.Invesigative methods were combined with construction. Trenches to be used subsequently for strip foundations or services were used to expose bedrock for inspection and treatment for a housing estate over area worked by long-wall coal mining .

Sessions 5, 6, and 7 considered general stability aspects of abandoned mineworkings, with regard to old room and pillar type works, long-wall coal mining (sessions 5 and 6). Session 7 dealt with a number of papers covering the limestone mines in the West Midlands and not only considered their stability assessment but also the remedial works carried out to stabilise them; hence some overlap with session 4.

 continued next page

Session 5. Abandoned mineworkings:

Five papers were presented of which three concerned coal mines and two Cretaceous limestone mines. Room and pillar mining was the most common type of mining considered. The coal mine papers consisted of two papers examining and classifying old coal mine workings, one restricted to shallow room and pillar coal mine of the West Midlands and the other the country as a whole as the mineworkings are exposed by opencast mines. In both cases empirical relations are developed indicating potential failure in terms of pillar and room size, as well as bulking factors of collapsed workings. The third paper developed a worse case scenario for deep abandoned mines in West Yorkshire. Should no instability be indicated by the worst case scenario then site investigation is not considered necessary.

Two papers considered mining in limestone. One considered room and pillar mining in the Cretaceous mines of South Limburg. The paper by Price and Verhoef adapt the tributary area method for assessing stability and suggests that the uniformity of the deposits of the south Limburg Limestones is suited to basic research in comparison to most mines. The other paper was on the Cretaceous limestones of southern England and considered more ancient Neolithic flint mining, lime mining for farming and natural karstic features. Disturbance by vibrations or heavy soaking usually cause these metastable features to subside. A rather gruesome case history in Norwich of a house in which its sleeping occupants died when the house dissappeared down a solution pipe which in turn had been undermined old limestone workings.

Session 6. Longwall mining:

Six presentations were given during this session of which two considered analogue and numerical modelling, three considered design of longwall mining and one geotechnical aspects of deep mining on a surface structure. The session was introduced by Professor Whittacker, professor of mining at Nottingham University. He illustrated model tests using sand to simulated long-wall mining subsidence. As long as the geology was well known accurate prediction of subsidence was possible. Engineering geologists had to extend their vocabularity: stowing, hydraulic, pneumatic, strippacking and caving terms were used to describe methods of excavation and roof support. The inland revenue (*belasting dienst, V.K.*) are interested in evaluating minerals. Mr. Vincent Harrison in their employ also developed a basic computer program to predict subsidence from long-wall mining.

For mines in very diverse areas: U.K. (Wales and Nottinhamshire), Kongzhuang (China) and Sigma (South Africa), design methods were given for developing their long-wall mining techniques. For Wales rock classification systems are used for assessing tunnel, gate and tunnel stability. Re-use of gate roads for adjoining long-wall panels is done to minimize sterilization of coal deposits. In China ascending mining is used to extract coal from dipping strata. The overburden is characterised into five zones which in-turn allows determination of deformations; the micro deformed zone, abutment zone, strata separated zone, the reconsolidated zone and the stable zone. In South Africa a two dimesional boundary element method is used to show that by staggering panels of upper and lower seams surface subsidence can be reduced.

continued next page

The last paper showed how considerable damage to a church was aggravated by deep coal mining widiening already open fissures of the magnesium bedrock limestone. Up to 2 m settlement of the church has occurred.

Session 7. Abandoned limestone mines in the West Midlands.

Eight papers were presented on limestone mines in the West Midlands all with particular reference to the abandoned Castlefields Mine at Dudley (west of Birmingham). The mine is in the Upper Wenlock Limestone of a Silurian inlier of Castle Hill, Dudley and was mined extensively from 1750's to 1910 when they were abandoned. Collapse of the mines can cause large crownholes to appear at the surface. The question of compensation for damage was discussed by Brook and Marker from the Department of the Environment. Additionally guidelines are being prepared to planning policy guidelines for future development. Three papers dealt with stability assessment of the Castlefields mine showing sections in the room and pillar working subject to overmining. The stability has been acoustically monitored to record roof collapses and has been correlated with rainfall. Joint patterns also affect the stability. A large part of the mine has subsequently been infilled with "rock paste", shale colliery spoil which has been sorted and turned into a paste. Three papers deal with this aspect. Two more pa..pers deal with the acoustic monitoring during infilling. The results indicate that roof falls have diminished considerably.

Session 8. Investigation of Underground Movements

The papers considered three case histories and one general paper on investigation `tricks' and `traps'. The case histories follwed the now fimiliar presentation of a problem caused by underground voids, their investigation and stability assessment and design. One consisted of old limestone working underneath the main trunk road from Edinburgh towards London. The paper was similar to a session 4 cost benefit paper; in this instance there appeared no instability, so three alternatives were considered: infilling or pillar reinforcement (to increase the safety margin or monitoring with annual maintenace. The last alternative was considered the least expensive. Subsidence potential of shallow mined coal seams in the Lanarkshire (Scotland) coalfield were investigated by boreholes. Down hole T.V. cameras were used to inspect remaining voids of panels and roadways and helped delineate risk areas on planning maps. After coal Permian sandstone mines of West Yorkshire were decribed in terms of investigation, instability and further mapping.

Typical features of old abandoned mines were given in a paper titled `Mining Subsidence Incidents' defined as "The surface manisfestation of ground movements caused by underground workings or the collapse of mine openings from the surface". Important was to obtain old mine records, determine frequency of failure, recognise surface features with respect to underground mining features and geology and recognise from inspection of records, blockage features in old workings (trees, rafts, masonary domes, walls/fences, classification of workings causing subsidence (shafts, mine openings, shallow workings, deeper workings) and a word on safety taking into account traps and danger of collapse for those carrying out inspection work.

continued next page

Session 9. Ground movements due to abstraction or injection of fluids.

Dr. M. de Freitas from Imperial College introduced the session by stressing the significance of water pressure changes in the ground which causes subsidence, consolidation or compaction (the latter due to cyclic changes water pressures; ie tides).

One paper took up the introductory theme: prediction of settlements in relation to sensitive structures due to dewatering of deep excavations for possible nuclear power stations in the Hampshire Basin area. Empirical correlations (from SPT, CPT and pressuremeter tests) were used to obtain parameters used to calculate settlements by elastic displacement theory in finite element models. The other two papers looked at soluble deposits of salt and gypsum. At Droitwich, Cheshire extraction occurred since Roman times. Uncontrolled extraction has caused considerable settlements (two stories!). Investigation has shown the creation of subsidence voids from the brine extraction occurs mostly in 'preferred' brecciated zones. The hydrology in the gypsum mines of Ripon, Yorkshire can cause initially swelling followed by subsidence. If the gypsum is in its non-hydrated state it forms anhydrite. The effects of water on anhydrite causes hydration to gypsum which is accompanied by swelling causing dramatic folding. The addition of further water gypsum goes into solution creating subsidence voids. Hollow patterns can be located by remote sensing (multispectral scanning) in non urban areas.

Session 10. Seismic effects:

Dr. D.M. McCann of the British Geological Survey introduced seismicity in terms of rock bursts as violent failures and resemble earthquakes; a decrease in potential energy on relase of strain energy due to mining. He referred to Neville Cook's work from the gold mines in South Africa where 62% of fatalities are due to rock bursts and can produce tremors up to 4.2 on the Richter Scale.

The three presentations complimented McCanns theme by considering totally different aspects of underground seismic effects. Micro seismic monitoring of pressure fracturing in a geothermal project can be used to predict increase of flows. In the South Wales coal field of Cynheidre coal mine early danger warnings of gas (methane) emissions or outbursts by seismic monitoring. These emissions have totally different spectra to that of other seismic sources from mining activities and occur with sufficient time alarming miners of the danger. The effects of dynamic loading on buildings from use of explosives in underground copper mining in Legnica, Poland are analyzed and suggestions made with regard to designing structures appropriately to withstand the shock waves.

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G.J. Oorthuys: Doctoraal (M.Sc. - TU Delft) thesis on computer techniques in the production of engineering geological maps

Review by P.M. Maurenbrecher, (Supervisor)

In October, 1987 G.J. Oorthuys completed his *doctoraal* thesis on using computer techniques for the production of engineering geological maps. The thesis has been divided into three sections:

1. The automation of the production of engineering geological maps, 43 pp., Part 1.

2. The production of a set of engineering geological maps at Fugro Geotechnical Engineers, Appendix Part 1, 7 pp.

3. Memoir on area A2, Amsterdam, Part 2, 7 pp. and 6 Appendices (Maps)

TU Delft: Centre for engineering geology in the Netherlands

The study is part of a larger project to produce engineering geology maps for Amsterdam. The participants, besides the Engineering Geology Section, TU Delft are the Amsterdam Municipality (Bureau Grondmechanica), the RGD (Geological Survey of the Netherlands, ITC (combined with TU Delft), VUA (Free University of Amsterdam), and Delft Geotechnics. The objective of this study was to produce a pilot engineering geology map for a district in Amsterdam. Although not a prerequisit for the study and to ensure TU Delft/ITC could play a useful role in the project the decision was made to use computer techniques to produce the maps. Oorthuys with the cooperation of M. 'Kam (*Nevenscriptie: Geological Map-Generating PC-Software, An orientational study, June 1987*) explored the range of mapping programmes available in the Netherlands that could be used to produce engineering geological maps. He reviews the systems explored, those systems published in the geotechnical/ engineering geological literature and the types of engineering geology maps appropriate for Amsterdam. One system, Fugro's Geodata Management programme, was chosen for trial maps as this system had been developed for the production of engineering geology maps.

The experience of using this system is given in the appendix to Oorthuy's thesis. The programme has been developed essentially for internal use so that time is required to learn its operation. Data input took time, a problem that exists for all programmes. In fact as his work progressed it became apparent that the ergonomics of data input which is essentially manual and thus time consuming, has potential for development. Systems such as reading devices may help surmount this hurdle. Also apparent as the project progressed as a whole, (independent of the Fugro exercise), was the lack of any adequate database system to allow rapid sorting or call up routines for engineering geological information.

The maps produced from Fugro Geodata management system are presented in an engineering geological memoir for section A2 the Amerika Haven area west of urban Amsterdam. Prominent is the fence diagram, the principal attribute of Fugro's system. At first sight the diagram appears confusing, but it has the merit as a useful tool to aid correlation in three dimensions. Correlation is done by the operator interactively with the computer. The 'fence posts' can be both soil profile legends and cone penetration profiles. Once correlation is complete (the wires spanning between the fence posts) the depths of correlation points are recorded from which isopach maps can be made of the various layers representing uniform geotechnical properties.

continued next page

Computer engineering geological maps continued...

Contouring is done using triangulation interpolation methods. The contour map presented with this review shows triangular shapes. This is attributed to the relatively low density of borehole and cone penetration test data in the Amerika Haven area. Other interpretation methods such as using Krige algorithms may produce more realistic but possibly less honest contours. Further development is to insert subroutines in the programme to calculate pile depth penetrations and settlements for a 'standard' pile and a 'standard' setttlement loading from the cone penetration tests.

The study is very much in a pioneering stage; the engineering geology section intends to encourage further development in database and mapping systems, especially, for example, in combining the numerous footloose geotechnical programmes into the larger mapping or database programmes. The experience of the entire project emphasizes, however, that the first priority is both to develop and standardize data input and to develop the mechanisms of sophisticated 'relational' databases to ensure data can be easily retrieved according to specific demands, analysed (if required) and fed into appropriate mapping programmes.

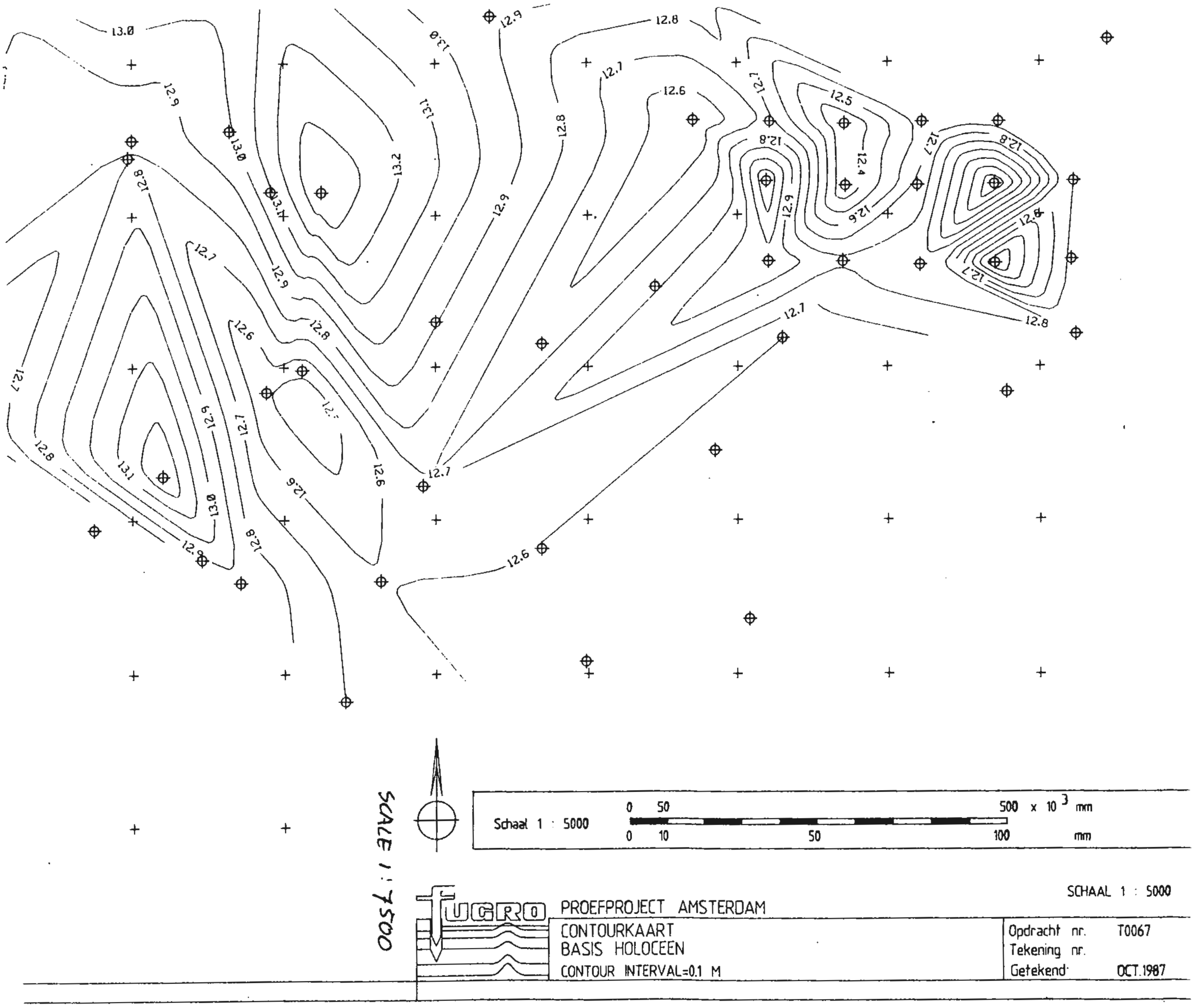

Figure: Contour map produced by triagulation of section of Ameika Haven, Amsterdam

QUALITY DESIGNATION OF LARGE ROCK BLOCKS

A problem encountered during the construction of the Eastern Scheldt Storm Surge Barrier was the handling and emplacement of the natural rocks used for the foundation of the structure. These rocks should fullfill strict specifications regarding weight and size distribution. Breakage of rock during transport or emplacement leads to the possibility that the rock does not fullfill the requirements. Experiments by Rijkswaterstaat (drop tests) on Finnish diabase and German basalt lead to breakage of about 20 and 8% of these rocks respectively. The average mass of the Finnish rocks dropped below the required amount.

Especially for large rock blocks, used in coastal protection works, it would be good to have a non-destructive method to determine whether this rock has concealed fractures which could lead to breakage during transport and handling. A method which is commonly used is to measure the akoustic velocity through the block and compare this velocity with the result one obtains on a small sample of the same material. If there are cracks in the rock block, the velocity in the block would be lower than in the sample.

In his thesis, Freek van Eijk developed an elegant method to handle the data obtained when measuring velocities through a rock block. With this method it is only necessary to perform a series of measurements (about 20) through the rock block in different directions and manipulate the data using a simple computer program. The outcome of this procedure gives a fair estimate of the probability of breakage of the rock during further handling or emplacement.

First Van Eijk performed tests on different types of rock in the laboratory, simply by placing blocks of rock on top of eachother, thus simulating one or two throughgoing, open, discontinuities (fig. 1). From the series of measurements the average velocity of the highest values (20% of the data), the "maximal velocity", was calculated (this velocity is supposed to be equal to the material velocity). It is assumed that the lower velocities (table 1) are delayed by the discontinuities present. All the velocity data are then divided by the maximal velocity. The resulting ratio, the "normalized velocity", enables different rocks (with different material velocities) to be compared. This procedure eliminates also the effect moisture content has on sonic velocity; the same rock tested wet or dry gave an identical nomalized velocity distribution, although the actual velocities measured could be quite different. The velocity ratio distributions obtained are studied using cummulative frequency diagrams (fig. 2).

The laboratory tests on different types of rocks resulted in typical distributions for one or two open, throughgoing, discontinuities. The normalized velocity distributions (analogous to the handling of grain-size distributions of soils) can be described using the R 90, R 10 and R 50 values (R 90:

Figure 1

Example of laboratory test of sonic velocity measurement through two blocks of carbonate sandstone.

With a CSI concrete tester the arrival time of an akoustic pulse was measured between various points. The points diametrically opposit the ones facing the page are coded A', B', C', ...G'. Resulting velocities are listed in table 1.

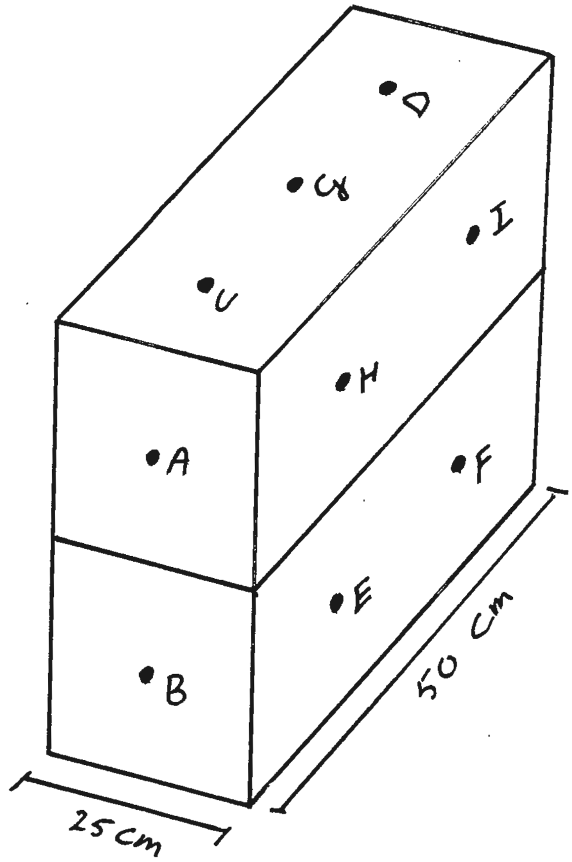

Table 1

Example of data set. Synthetic carbonate sandstone with one open discontinuity (see fig. 1)

	velocity (m/s)	V/V max	cum.%	
EE'	1867	1.005	100.1	
II'	1864	1.004	100.1	
HH'	1851	0.997	89.6	
FF'	1846	0.994	89.6	V max = 1857 m/s
CC'	1691	0.991	79.1	
BB'	1683	0.906	79.1	
EH'	1667	0.898	68.6	
AA'	1620	0.872	68.6	R 90 = 1.0
DD'	1539	0.829	58.1	R 50 = 0.8
HE'	1447	0.779	52.8	R 10 = 0.45
GG'	1421	0.765	52.8	
AB'	1304	0.702	42.4	R 90/R 10 = 2.22
BA'	1280	0.689	36.9	
CE'	1134	0.611	31.6	R90/R10/R50 = 2.8
FH'	1100	0.592	26.3	
FI'	922	0.497	21.0	
IF'	910	0.490	21.0	
DC'	835	0.450	10.5	
HF'	435	0.234	5.3	

90% of all the data fall below that value) (fig. 2). Using the R 90/R 10/R 50 value a neat distinction can be made in rocks with one or two open throughgoing discontinuities (fig. 3). Fig. 4 shows a diagram with all the data obtained by Van Eyk on the rocks measured in the laboratory and in the field. The latter include data obtained by T.N.O. on large rock blocks used in drop-tests, where before and after each drop the velocity distribution was measured. Fig. 4 shows clearly the potential of the method. A rock falling in the area bounded by the lines R90/R10/R50=1.5 and 3.0 has a normalized velocity distribution similar to that of a rock with one, open, throughgoing, discontinuity (see fig. 3). A point to the right of the line R 90/R 10/R 50 = 3.0 has at least the equivalent of two open discontinuities. It is expected that such rocks are very sensitive to breakage.
A next step in the investigation, which is carried out in cooperation with the "Dienst Weg- en Waterbouw" of Rijkswaterstaat, will be to establish a critical R 90/R 10/R 50 value for which overbreak occurs in rock blocks. This research will involve investigations in different quarries in Europe using drop tests and winning-transport-emplacement studies.

The research is part of the project "Geological Construction Materials" supervised by Peter N.W. Verhoef.

F.C.C.A. van Eijk (1987): "Exploration and exploitation aspects of large armourstone blocks. Quality designation for large rock blocks." Memoirs Centre of Eng. Geology, Delft, No. 42.

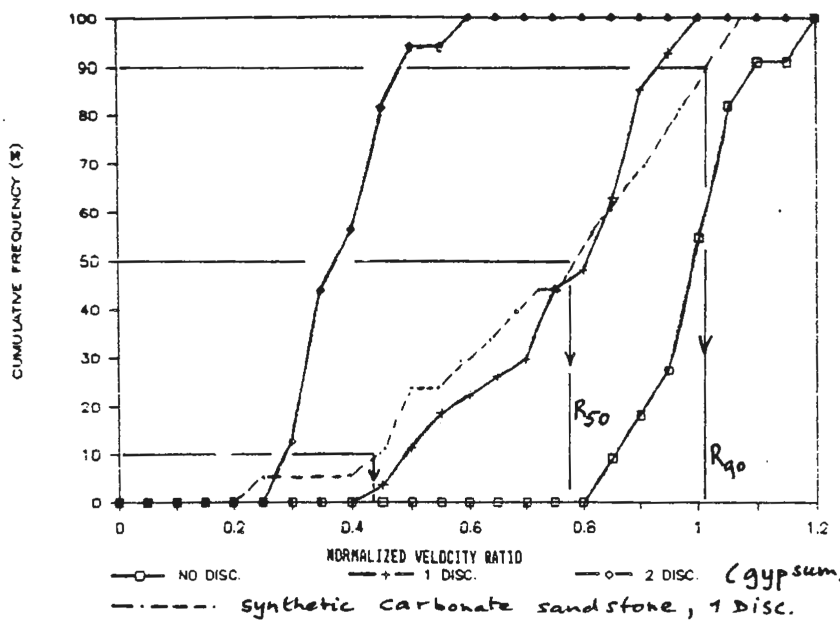

Figure 2. Normalized velocity frequency curves for gypsum blocks with no, one or two discontinuities. The results of the test of fig. 1 and table 1 are also plotted, showing determination of R values.

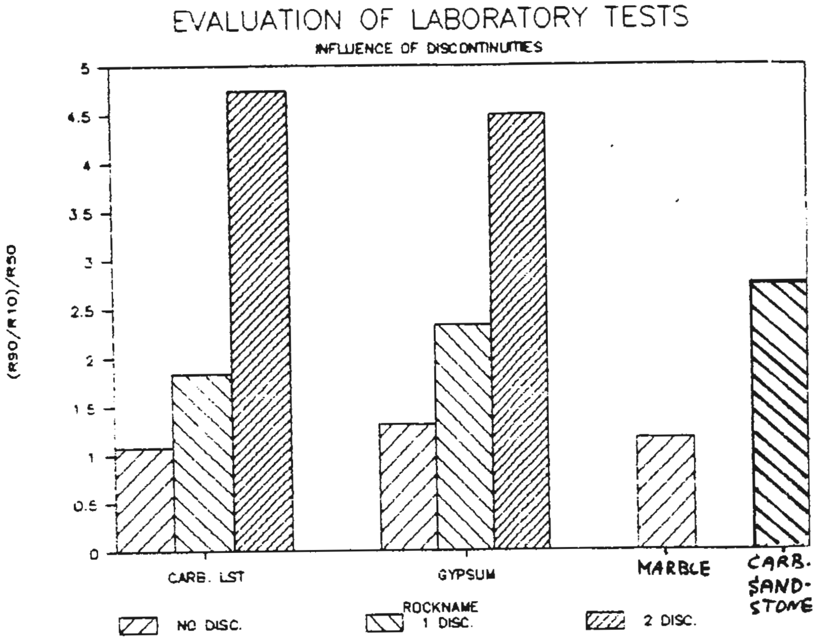

Figure 3. The value (R90/R10)/R50 determined from the frequency distribution of the normalized velocities gives a convenient discrimination between intact rock and rock with one or two open discontinuities.

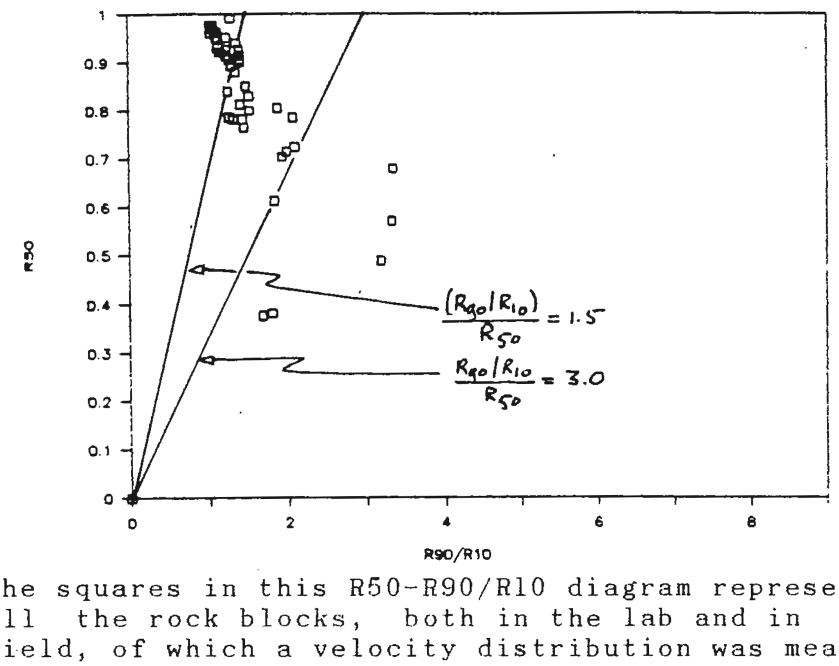

Figure 4. The squares in this R50-R90/R10 diagram represents all the rock blocks, both in the lab and in the field, of which a velocity distribution was measured by Van Eijk. Also included are data obtained by TNO on dunite blocks. Rocks to the right of the 1.5 line are suspect of having open cracks.

ABSTRACT

In order to make an approximation of the stability conditions of a room and pillar mine in the Maastrichtian Limestone in South Limburg, The Netherlands, a stability analysis of the Geulhem workings near Berg en Terblijt has been performed.
In this analysis the strength of the pillars has been related to the material strength by means of a size factor and a shape factor. Because the calcaronites of the Maastrichtian formation have a large degree of homogeneity and isotropy, the strength factors have been determined after tests on aerated concrete, a model for homogeneous and isotropic carbonate rock.
Besides the stability analysis, the pillars have been investigated in the field and classified on their condition in the process of failure. The stability analysis proved to correlate with the actual situation underground.

INTRODUCTION

In South Limburg, The Netherlands, people have been extracting carbonate rock for ages to use it as a building stone. In many places abandoned room and pillar mines are present. Still people visit those workings and also parts of town or factories have been built on top of the mines. In the future an evaluation might be made to use the existing open space underground for energy storage or waste disposal. For this reason it is important that the stability of those workings can be evaluated in great detail.
This article gives an outline of the work of Van Steveninck (1987) to obtain his Ir-degree (M.Sc.) in Engineering Geology at the Technical University of Delft, faculty of Mining and Petroleum Engineering. It describes a stability analysis of the Geulhem workings near Berg en Terblijt and a classification system, developed to classify pillar on their stage in the process of failure.

THE TRIBUTARY AREA METHOD

To determine the condition of stability of room and pillar mines most often the tributary area method is used. For every pillar a safety factor is calculated by comparing the stress in the pillar with the strength of that pillar.
The stress in a pillar can be calculated by taking the weight of the column of material above the tributary area of that pillar. This weight is imposed on the pillar area.
The open space around the pillars, the "room", is equally divided between the pillars. These areas are called the tributary areas. The pillar areas are the actual load bearing areas. They might be reduced by a weathered or damaged zone, which is considered not to be able to bear any load. Therefore, the pillar stress S_p is:

$$S_p = S_v * (A_t/A_p) \quad \ldots\ldots\ldots (1)$$

where S_v is the vertical stress, A_t the tributary area and A_p the load bearing pillar area (see also fig. 1 and 2).
The strength of a pillar is related to the material strength. The material strength is determined by the unconfined compressive strength of a small cylindrical sample. A mine pillar differs from a small laboratory sample in two ways, the size and the shape. The relation between the strength of small samples and large samples is reflected in the size factor. The shape of a

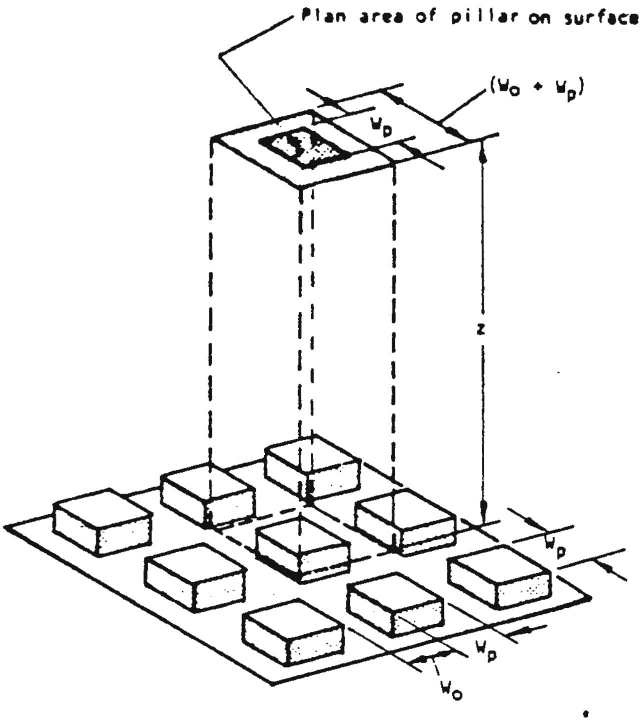

Fig. 1: The stress in a pillar (after Hoek and Brown, 1980)

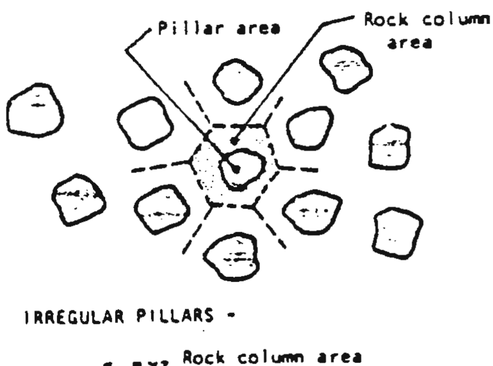

Fig. 2: The tributary area (after Hoek and Brown, 1980)

sample can be described in the width/height-ratio. The relation between width/height-ratio and strength is reflected in the shape factor. Hence,

$$\sigma_p = \sigma_o * N_{size} * N_{shape} \quad (2)$$

The safety factor can now be calculated as $F = \sigma_p / S_p$. The reciprocal value of the factor of safety is the pillar load as a percentage of its strength. For example, a pillar with a safety factor of 2 is loaded up to 50 % of its strength.

THE EFFECT OF SIZE AND SHAPE ON THE STRENGTH OF BLOCKS OF AERATED CONCRETE

The size effect is caused by the difference between material and mass. A material is the basic constituent of a mass. The mass may include discontinuities. The apparent strength of a large specimen can be smaller than the apparent strength of a small specimen, due to the influence of discontinuities.

The shape effect is caused by the non-uniform stress field within the sample. A high and narrow specimen has a smaller apparent strength than a low and wide specimen.

To determine the size and shape factor of a homogeneous and isotropic material that acts as a model for the carbonate rock from the Maastrichtian Limestone formation, present in South Limburg, The Netherlands, cellular concrete has been taken.

The possible size effect has been investigated by doing compressive strength tests on cubical samples with varying size. The results of those tests are shown in fig. 3. It is obvious that no size effect was measured.

The effect of the shape has been investigated by testing a series of prism shaped samples with identical width, but with increasing height. As shown in fig. 4 the results show a logarithmic tendency. To be able to compare the values also a standard unconfined compressive strength test has been performed.

The equation which describes the pillar strength of aerated concrete is as follows, with $N_{size} = 1$ and $N_{shape} = 0.935 + 0.690 \log(w/h)$:

$$\sigma_p = \sigma_o * (0.935 + 0.690 \log(w/h)) \quad (3)$$

THE CLASSIFICATION OF MINE PILLARS

In a pillar the stress can be determined using the previously mentioned formulae. This is, however, an average stress in the pillar. There exists a distribution of stress within the pillar. In the corners the stress concentration is at highest and in the centre of the pillar the lowest stress concentration is present.

Based on this stress distribution and on field observations a classification system has been developed. In table 1 the various classes are defined.

In the field it can be observed that the failure of a pillar initiates in the corners (class 2). Thereafter the concentration of stress is at highest at the roof/pillar contact and cracks will develop there too (class 3). The process of failure progresses and on the entire pillar surface cracks begin to develop (class 4). In the end large blocks fall out of the pillar and it is assumed failed (class 5).

THE SAFETY FACTOR AND THE CLASS OF A PILLAR

Besides a classification of the pillars, a stability

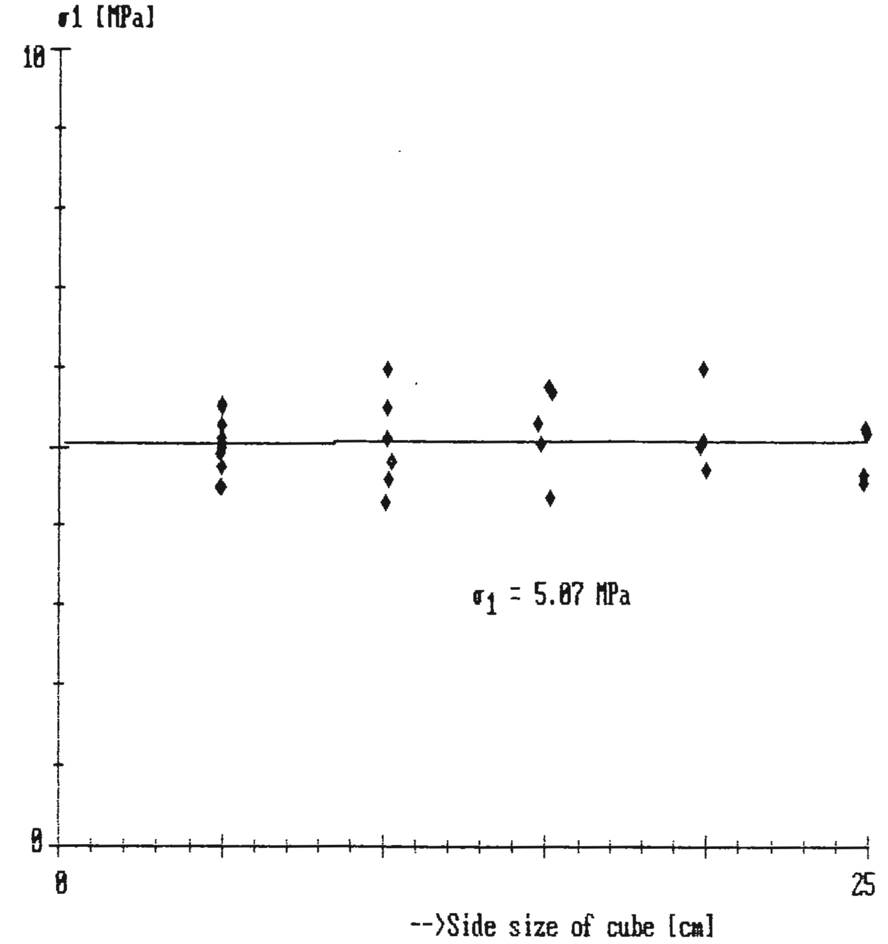

Fig. 3: The size effect of aerated concrete (after Van Steveninck, 1987)

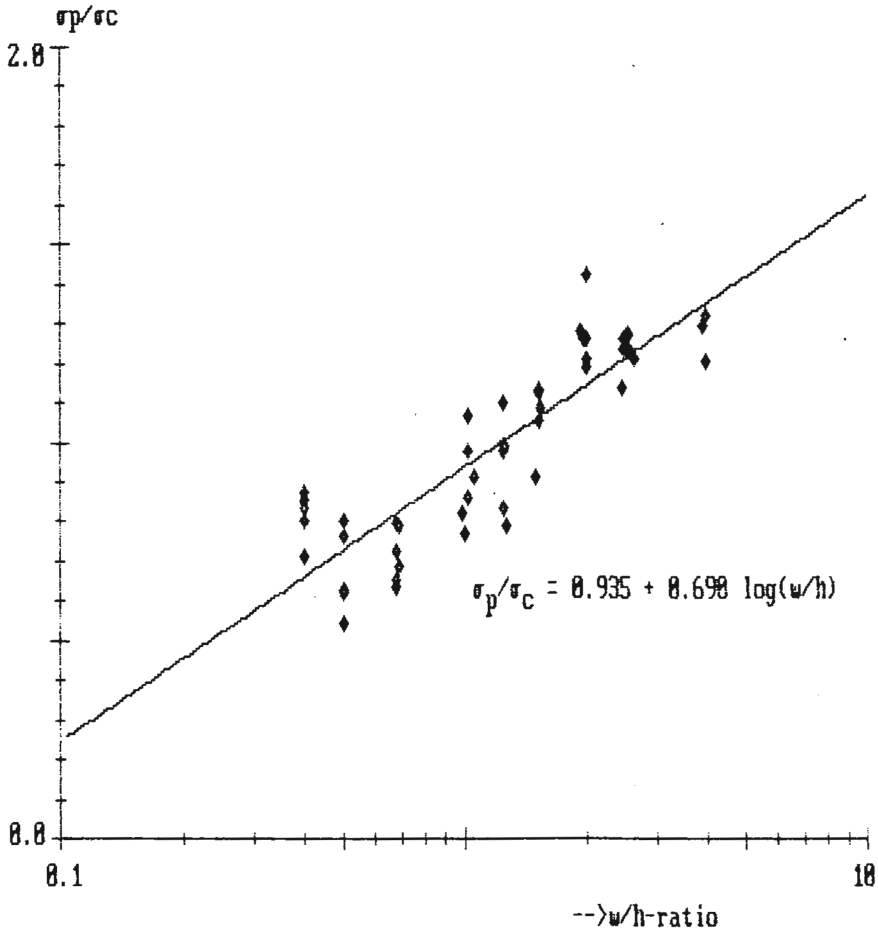

Fig. 4: The shape effect of aerated concrete (after Van Steveninck, 1987)

analysis can be undertaken. Afterwards, if the safety factors for every pillar are compared with their classes, large safety factors must be found for class 1 pillars and smaller factors of safety for class 2 to 5 pillars. Class 5, failed, pillars must have safety factors below 1.
In the Geulhem workings near Berg en Terblijt, The Netherlands, a correlation of safety factors and classes of pillar is made. This correlation is presented in table 2. All the pillars in the mine have been classified. With aid of the tributary area method a stability analysis has been undertaken. The material strength has been determined and eq. 3 has been used to evaluate the strength of the pillars.

CONCLUSIONS, RECOMMENDATIONS

The correlation class of pillar - safety factor of pillar shows a decrease in safety factor from class 1 to 5. However, the numerical values might not be correct due to several reasons.

(*) The tributary area method provides safety factors, which are valid shortly after the first extraction. Due to the neglecting of the time effects, long term creep, weathering, etc.,too large safety factors are probably found for the different classes of pillars. The deviation might be different for each class.

(*) Inaccuracies in the determination of the material strength introduce a systematic error in the value of the safety factor.

(*) The transfer of stress from small pillars to neighboring large pillars or from the mine to the surrounding rockmass, resulting in too low safety factors has not been taken into account.

In the future the influence of the above mentioned factors on the safety factor must be examined thoroughly.
The determination of the size and the shape effect could be improved. A better description of the shape of irregular pillars than only width/height-ratio and the influence of discontinuity systems on the size are examples of improvements.
More attention must be paid to the stress distribution within pillars and the theoretical relation to the class of the pillar. Finite element methods might be of great help.

REFERENCES

Hoek, E. and Brown, E.T. Underground excavations in rock. Inst. Min. Metall., London, 1980.
Steveninck, R.v. Past mining in the Maastrichtian Limestone. Mem. Centre of Eng.Geol. in The Netherlands, Delft, 1987.

Class	Description
1	Pillar without any cracks
2	Cracks occurring only in the corners
3	Cracks along roof/pillar and floor/pillar contact
4	Cracks on the entire pillar surface
5	Failed pillar

table 1: pillar classification (after Van Steveninck, 1987)

Class	Safety factor
1	> 3.5
2	= 3
3	= 2.5
4	= 2
5	< 1

table 2: class and safety factor (after Van Steveninck, 1987)

Reportation rock seminar meeting.

Every month the rock seminar organises a meeting with different lectures. On October 16th the following lectures have been presented:

- -The application of the tributary area theory to develop hazard maps. (by R. van Steveninck)
- -Results of the conference on "Engineering Geology of Underground Movements" held in September in Nottingham(U.K.). (by P.M. Maurenbrecher, M.Sc.)
- -Model study of instability phenomena in the St. Pietersberg room and pillar workings using a base friction machine. (by Ir. A.A.M. Vermans)
- -Stability of abandoned mine workings in Maastrichtian Limestone. Results of the latest research. (by Drs. P.N.W. Verhoef)

The first two lectures about the tributary area method and about the conference in Nottingham are extensively described in this Newsletter. Short abstracts of the other two lectures are given below.

The model study of instability phenomena in the St. Pietersberg room and pillar workings using a base friction machine.
(by Ir. A.A.M. Vermans,GMD)

In the study of instability in the South Limburg room and pillar workings, the need was felt to study the behaviour of a system of collapsing pillars. For this purpose, model tests on a 1:80 scale have been performed in a newly developed base friction machine. Since fifteen years, the base friction principle has been used to reproduce effects of gravity in two-dimensional physical models. The body force of gravity is reproduced by the drag of a belt moving along the back side of the model. The conditions for model-prototype analogy and the inherent short comings of the base friction technique were illustrated by simulation of instability phenomena in a model of the St. Pietersberg room and pillar workings. The usual method of stability-analysis was extended by including geological factors in the model. One of the main problems which occured during the test on this model was that material moved into the third dimension. And while this is supposed to be a two dimensional model the test results were a bit distorted. In the end an attempt was made to relate fracture patterns observed in the model to their residual strength.

Stability of abandoned mine workings in Maastrichtian Limestone. Results of the latest research.
(by Drs. P.N.W. Verhoef,TUD)

The section Engineering Geology of the faculty of Mijnbouwkunde en Petroleumwinning of the Technical University Delft have done much research on mine workings stability in Maastrichtian Limestone. In the past many tests have been done in the ENCI quarry in South Limburg. On this moment the focus point is on the Geulhemer mine also in South Limburg. The application of the different fail mechanisms are tested.
Future research will be on pillar failure, roof collapse, mine collapse, fracture detection, in-situ stress determination, hazard mapping and on remedial measures.

If you have questions or want more information about the rock mechanics seminar you can contact them at the undermentioned address.

S.J.Plasman

ROCK MECHANICS SEMINAR

An Interuniversity Seminar

Organisers:	Professor D.G. Price C.Eng.	(Fac. Mining & Petr. Eng. TUD)
	Professor ir. J. de Koning	(Fac. of Mechanical Eng. TUD)
	Professor ir. P. van Leeuwen	(Fac. Mining & Petr. Eng. TUD)
	Professor ir. H.P.S. van Lohuizen	(Fac. of Civil Eng. TUD)
	Dr. N. Rengers	(ITC Enschede)
	Dr. C. Spiers	(Inst. of Earth Sciences RUU)
	Drs. P.N.W. Verhoef, secretary	(Fac. Mining & Petr. Eng. TUD)

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BOOK REVIEW: Earthquake Engineering

Fifth Canadian Conference.

Balkema 1987.

The book, some 880 pages long, is the Conference Proceedings of Fifht Canadian Conference on Earthquake Engineering, which was held in Ottawa on 6th to 8th July 1987. As such it cannot be considered as a textbook, presenting a reasoned and balanced account of the science of earthquake engineering. The conference dealt with seven themes. These were

1. Response analysis and design of structures and structural comparents (31 papers).

2. Soil stability and soil structure interaction (19 papers).

3. Special structures and critical facilities (9 papers).

4. Lifetime, utility, telecommunication and transportation systems (3 papers).

5. Ground motion, seismicity and seismic risk (8 papers).

6. Seismic codes and standards (5 papers).

7. Experimental methods and tests (13 papers).

In addition to the 88 papers presented there were five "keynote" lectures, representing "state of the art" statements in five aspects of earthquake engineering.

Of the seven themes, themes 2, 5 and 6 contain papers which are of direct interest for engineering geologists. The other themes contain papers wich relate mostly to the structure rather than to the ground on which it is built.

Theme 2 is divided into two sections and it is the second, entitled "Soil Stability" which contains seven (out of a total of eight) papers dealing with liquefaction. While all of these seven contained information of value I found the more pragmatic papers of Hasada, Yasuda and Isoyama (2 papers) and Soydemir of greatest interest, for these dealt with actual experience rather than laboratory work or theory.

Theme 5 deals with some aspects of the fundamentals of seismic risk assessment. Probably the most interesting paper for engineering geologists in the Netherlands is that by Muir, Wood and Woo, which deals partly with the seismo-tectonics of North West Europe. However, the paper is rather brief. for me the most interesting paper in this section was that by Amick et al. In this the authors have sought to find relationships between reservoir induced seismicity and the lithology of the reservoir area. A relationship between the time to the first R.T.S. (Reservoir Triggered Seismicity) after impounding and the reservoir lithology appears to exist.

Theme 6, seismic codes and standards deals mostly with structures but it is useful to know now the development of codes is progressing. One paper, that by Heidebrecht and Naumoski, deals with site response and site investigation.

Of the "keynote" papers, that by Boore "The estimation of ground-shaking caused by earthquakes", contains some useful information. Another, by Mitchell, is an interesting account of structural damage caused by the 1985 Mexico City earthquake.

All in all, this volume presents the usual wide range of papers presented at any conference. It is a reference work which should be in the library of all those institutes concerned with earthquake engineering.

Prof. D.G. Price, C.Eng.

Verslag van de lezing: Earthquake hazards in North West Europe
door: Dr. Collin Davenport van de Strathclyde University
op: 7 juli 1987

Allereerst werd een overzicht gegeven van de aarbevingen in Europa, met name aan de noordrand van het Adriatische subschild en de Rhine Graben, en deze vergeleken met de aardbevingen in Noord West Europa.
In vergelijking met de aardbevingen in het Alpine gebied worden die in NW Europa gekenschetst als "of minor importance" en zelfs als "of trivial importance". Dit tot het begin van de tachtiger jaren.
Onderzoekingen echter door Davenport en een team van de universiteit van Strathclyde geven de stellige indruk dat zelfs aardbevingen met kleine amplitude en een ondiep epicentrum, op korte afstand (tot 10 km) van dit epicentrum in de Holocene afzettingen geleid hebben tot aantoonbare veranderingen als offset, slumping en liquefactie. Fenomenen die van groot belang zouden kunnen zijn voor constructies als kernreactors en andere civiel technische werken.
Een historisch overzicht met name voor wat de sterkte (geschat 5 tot 6 op de Richterschaal) van deze aardbevingen is nog zeer onvolledig. Hierdoor zijn pogingen om tot een soort risk assessment te komen bepaald nog niet zo exact als de constructeur van civiele werken graag zou zien.
Er zijn gedocumenteerde aanwijzingen dat de laatste veertig duizend jaar betrokken moeten worden in het historisch onderzoek. Verder zijn er sterke aanwijzingen dat een aantal landslides, met name in Schotland en Engeland, getriggerd zijn door een optredende aarbeving met een epicentrum in de basis van het Holoceen.
Veel onderzoek zal nog verricht moeten worden voordat met voldoende mate van zekerheid gezegd kan worden of aardbevingen van invloed zouden kunnen zijn op constructies met geprojecteerde levensduren van 100 of 1000 jaar.
Aanwijzingen voor in historische tijd opgetreden aardbevingen zijn te vinden in de Holocene sedimenten van een aantal Lochs (nu alleen een kleine rivier bevattend) in het westen van Schotland. Een eenduidige verklaring van slump structuren en liquefactie fenomenen zijn niet gemakkelijk te geven. De aanwezigheid van faultlines en faultzones in de directe omgeving van deze sedimentatiestructuren zouden kunnen wijzen op een seismisch geinduceerde oorzaak voor deze structuren.
Of het onderzoek van Davenport cs via de universiteit van Strathclyde overdraagbaar is naar de situatie in het deltagebied van Maas en Rijn zal pas na een gedegen onderzoek kunnen blijken.
Verder zou de in Schotland aanwezige bedrock aan de oppervlakte of op geringe diepte een essentiëel verschil kunnen uitmaken bij de vergelijking.
Zoveel is zeker dat een aantal vcerplaatsingsstructuren in het Holoceen van NW Europa waarschijnlijk verklaard kunnen worden zelfs vanuit de laag seismische activiteiten in dit gebied.
Als dit werkelijk aantoonbaar is kan een onderzoek van historische seismische activiteiten een belangrijke, zo niet essentiële, aanvulling zijn op de ingenieur geologische onderzoekingen voor civiel technische werken.


Merry
Christmas
and a
Happy
New Year


The
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and the
INGEO-
KRING