SANIRE
SOUTH AFRICAN NATIONAL INSTITUTE OF ROCK ENGINEERING

ROCK talk

A Bi-ANNUAL NEWSLETTER WITH THE LATEST BUZZ AMONG ROCK ENGINEERS

VOLUME 1, ISSUE 1 JANUARY 2015

ISRM

INSIDE THIS ISSUE:

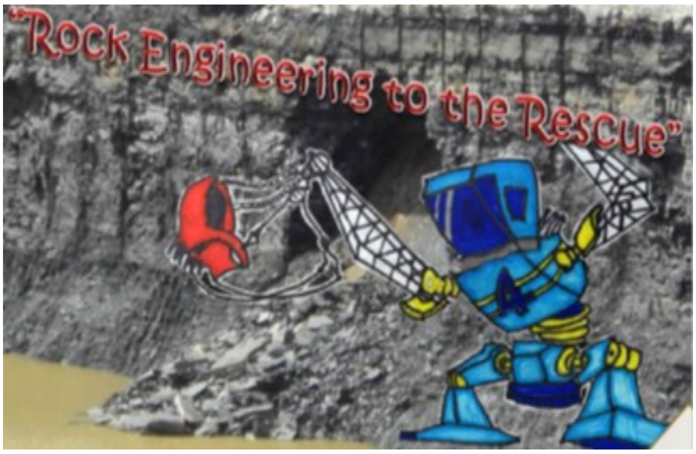
SANIRE SYMPOSIUM 2014

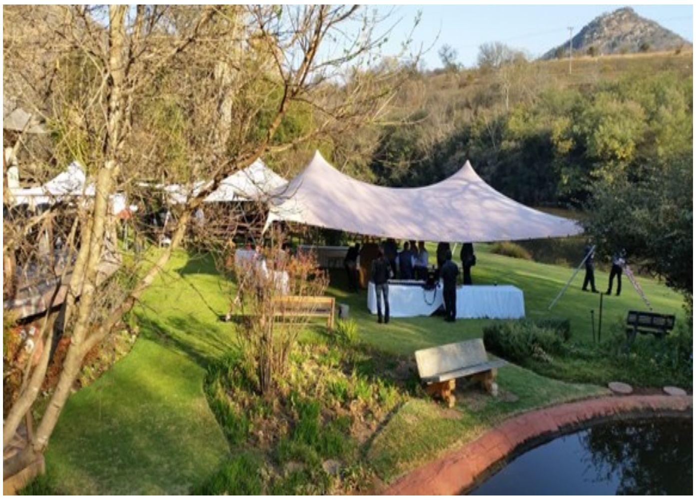
The 11th of September 2014 saw the SANIRE Coalfields Branch hosting the annual SANIRE symposium for the second time since the 1989 SANGORM Symposium.

One of the very first annual SANIRE symposiums was held in 1986 and there have been more than 20 symposiums since then.

The decision that the 2014 Symposium would be hosted by the Coalfields Branch was taken at the SANIRE Bosberaad Meeting held on the 19th and 20th of October 2013, and since that day it has been all systems go for the Coalfields committee. All in all various members on the committee met to discuss the arrangements and planning more than 8 times over the following 9 months in the lead up to the Symposium to discuss, amongst other Rock Engineering related aspects, the requisite planning and arrangements for the Symposium.

Continued on page 7…………





SANIRE ANNUAL GENERAL MEETING

The Annual General Meeting was held on the 7th November2014 at the

West Wits Conference Centre

AngloGold Ashanti

The event was well attended by SANIRE members from across the country.

SANIRE
SOUTH AFRICAN NATIONAL INSTITUTE OF ROCK ENGINEERING

Salamon Awards

Marcus Mathey & Nielen van der Merwe

Ortlepp Award

Marcus Mathey

Practitioner of the Year

Willie Liebenberg

Honorary Life Member Award

Johan Klokow

Best students of the Year

Theo Pheluskagogo (UP)

Daniël Ngwarati (WITS)

COMREC Tickets 2014

Mia Jordaan
Franz Bruwer
Salmon van der Wath
Ryno Muller
Sampie Potgieter
Nduduzo Khathi
Marc Henderson
Jacques du Toit
Daniël Rakometsi
Rofhiwa Malogwa
Humbelani Netshifhire


William Joughin and Markus Mathey

Markus Mathey


William Joughin and Nelen van der Merwe


William Joughin and Willie Liebenberg


Sandor Petho and Johan Klokow

Continued.....................

Best Candidates -2013

Katlego Patricia Mathibe	SCO	87%
Jimmy Godfrey	Paper 1	77%
Nduduzo Khathi	Paper 2	79%
Deinol Jones	SCO -Met	81%

Recognition (above 75%)

Masala Godfrey Nelufule	SCM	84%
Boitshoko Naledi Ramaboea	SCM	81%
Ethan Ryan Le-grand Godfrey	SCM	79%
Gain Baloyi	SCM	78%
Arno Jacobs	SCM	77%
Kgomotso Maketa	SCM	77%
Ngoanakgopa R E Seabela	SCM	77%
Tebogo M.M. Matlala	SCM	76%
Anza Ndzimeni	SCM	75%
Daniël Legoabe	SCM	75%
Mashudu Ramathaga	Paper 1	76%
Frans Bruwer	Paper 1	75%
Dewald Lamprecht	Paper 2	78%

Best Candidates - 2014

Ricardo Gonsalves	SCC	77%
Justin Winnan	SCM	89%
Darryl Slawson	Paper 1	85%
Ivan Wright	Paper 2	86%
Nilis Enya	Paper 3.3	80%
Henri Jordaan	SCM	75%
Gordon Rabey	Paper 1	77%
Calvin Gloster	Paper 1	76%
Deinol Jones	Paper 1	75%
Alan Wright	Paper 2	83%


William Joughin and Nilis Enya


William Joughin and Ricardo Gonsalves


William Joughin and Justin Winnan


William Joughin and Ivan Wright


William Joughin and Deinol Jones


William Joughin and Darryl Slawson

SAIMM PLATINUM CONFERENCE 2014

The SAIMM International Platinum Conference 2014, hosted at Sun City between the 20 October 2014—22 October 2014, was well represented by SANIRE members who presented three technical papers.

The Rock Engineering Session was covered by Michael Du Plessis (Lonmin), Alida Hartzenburg (Lonmin) and Paul Couto (Northam Platinum).

The titles of the papers presented were as follows:

Designing controlled pillar failure – crush pillar support — Michael Du Plessis;

The influence of regional structures associated with the Bushveld Complex on the mechanism driving the behaviour of the UG2 hangingwall beam and in-stope pillars as identified on Lonmin — Alida Hartzenburg;

Flexural Slip Thrust Faulting on Booysendal Platinum Mine and the effect on the Rock Engineering Fraternity — Paul Couto.

SANIRE SURVEY—AWARDS

SANIRE approach for 2015 in terms of raising funds and issuing awards: would members prefer the following:

A. That a banquet ball be held where awards are presented (an evening dinner where partners attend at a cost); or

B. That awards be presented at the AGM.

Please submit your reply to Paul Couto, stating the title 'SANIRE SURVEY—AWARDS' and the option chosen.

The results will be published in the next edition

Paul.couto@norplats.co.za

ROCKY JOKES

The following statements have been made during exams and in routine reports. They were not funny at the time but when we look back at them its makes for a good chuckle.

1) ………...and grouting seemed to be a suspect

2) It necessary to make use of Impact Wrench or Tongue Wrench

3) It is recommended to make use of the weakest explosives available on the market

4) Pothole – the reef runs into the footwall, so you cannot see the reef so you cannot mine it

5) Geophone – use to look for geological features in the rocks

Engineers Rock!!!!!!

An Engineer found R100 while walking home from work and he chose to go into a 5-Star Restaurant and order drinks for the entire house. The bill was R 6 000. He was unable to pay the bill so the Manager called the Police. The Police arrested the Engineer, and he gladly left with them. On the way to the Police station, the Engineer gave the Police R 100 to set him free.

That's good financial management.

"ROCK ENGINEERING TO THE RESCUE"

Continued…….

Due to the extremely large scope and significant amount of planning and work that goes into the hosting of such an event, the Coalfields Branch committee took an informed decision to reach out to a number of additional SANIRE members within the coal industry for help with a number of different aspects related to the Symposium.

An individual who went out of her way to assist and advise wherever possible was the aptly named "Symposium Consultant" Lelanie Prinsloo. Lelanie was also responsible for the design of the dragline and roofbolter "goggo's", which would later adorn the brochures and posters.

Behind the scenes the Chairman's wife Diane Petho was working tirelessly designing and compiling all of the brochures, announcements, posters, name tags, name lists and also selecting and wrapping the gifts, to ensure that everything on the day went along smoothly and in a professional manner.

The committee also took a decision to, as far as possible; ensure that the symposium had a more personal feel to it, for all of the delegates, from the Rock Engineering Practitioners to the Sponsor Representatives. A conscious effort was put in to ensure that each of the speakers, and event sponsors felt involved and was kept informed of the arrangements at all times.

One of the more difficult decisions that any organizing committee has to make is the selection of the "ideal" venue. Due to the huge geographical area in which the Rock Engineering practitioners are located, as well as the fact that the exact number of delegates who typically attend the Annual Symposiums has been known to be particularly difficult to predict, a number of different venues had to be investigated.

One of the sponsor representatives, Danie Blom, took it upon himself to personally conduct a detailed investigation into all of the relevant different aspects of the potential venues in order to allow the committee members to make an informed decision regarding the selection of the venue.

Each venue was rated on aspects including cost, catering, parking, location, technical support etc. and based on the findings of the investigation; the committee took the informed decision that the symposium to be held on the 11th of September 2014 would be held at Glenburn Lodge.

Based on previous symposiums the initial number of delegates who were expected to attend the symposium was put at approximately 100, a number which proved in the end to be a gross underestimation.

As the date drew closer the names of delegates attending continued to pour in with the number of delegates attending having to be increased from 120 to 140 a mere two weeks before the event. Even so on the day the number of 140 proved again to be a slight underestimation with the final number of registered delegates on the day being 141.

After months of preparation, meetings and planning the day of the symposium finally dawned and 5:30am found the committee members arriving on site to finalize the venue preparation and ensure that everything was ready for the delegates when they started arriving at around 7:00am.

Thankfully, one of Mother Nature's greatest variables, the weather, played along and ensured that the picturesque venue that Glenburn Lodge is could be enjoyed in all its splendor.

Generally the symposium was a huge success with the wide variety of topics ensuring that all of the approximately 141 delegates were kept interested throughout the day and that everyone was able to take home a number of valuable learnings relevant to their specific work environment.

The exceptionally high standard of presentation and supporting research was set from the onset with the key note address being given by Professor Nielen van der Merwe of Stable Strata Consulting who presented the most current research related to strength calculation formulas for coal pillars and the fact that so often in life, the more we know, the more what we thought we know, we need to change.

The presenters who followed maintained the same high standard of research and presentation with topics ranging from, the monitoring of surface subsidence using satellite imaging techniques to, the effects of extremely high temperatures on the mineral properties of rocks and what geotechnical conditions could be anticipated when South Africa's mining industry reaches ultra-deep level mining areas.

True to the common saying "last, but not least," a highlight of the day was the presentation by Pieter Colyn which was in fact the very last presentation of the day, in which Pieter discussed his paper on the "Legal Liability of Rock Engineering Personnel," a presentation which was unusually well attended for its position in the day's proceeding, and quite understandably so.

As can be expected, there were a number of glitches on the day including some technical difficulties and simply the fact that the sheer quantity and value of the information which was to be communicated via the presentations on the day, resulted in what turned out to be a considerably long day, and a number of presentations running over time, literally "eating" into the break times and therefore impacting on the opportunity for delegates to network.

That said, all in all, it is safe to say that the 2014 national SANIRE Symposium, hosted by the Coalfields Branch, was a huge success, and that each and every delegate who attended on the day would have left that evening knowing that it was a day full of learnings and opportunities and ultimately one which was very well spent.

A big thank you needs to be extended to all of my fellow Coalfields Committee members for making the event a success. Also a special word of thanks needs to be extended to the videographers on the day, Dewald Swanepoel and Carl Krog, as well as the photographers Danie and Frik Blom, the father and son duo, for all their hard work behind the scenes.

Also a final word of thanks needs to be extended to all of our 16 sponsors, and 16 speakers for affording us the opportunity to present the Symposium.

We look forward to seeing you all next year when we as SANIRE, take the success of the 2014 Symposium and use it as a spring board to propel the SANIRE members as well as the mining community as a whole to even greater heights.

PERSONALITY OF THE QUARTER

Full Name: Noel Delphin Fernandes

Position: Group Rock Engineering Manager

Company/Organisations: Impala Platinum Mines

Date and Place of Birth: 1961/12/24, Virginia, OVS.

Education: Barberton High School

First Job: Onsetter (during School Holidays), Electrical Apprenticeship, Sheba Gold Mine in Barberton, then started as a learner official mining at Buffelsfontein Gold Mine.

Personal Best Achievement/s: Establishing a great rock engineering department which has stayed together for so many years. When rock engineers were travelling around following all the best paid jobs, the Impala team stayed together. We fight a lot but all for the right reasons.

Favourite Food/Drink: Typically porra, peri peri prawns and Coke

Favourite Sport: To watch Rugby and Athletics. Did karate for many years. Now I get "milt steek" watching sport on TV.

Philosophy of Life:

If you don't like it don't do it. Life is too short to do something you don't like to do.

1. How did your career in the mining industry begin and where are you now?

Started as a learner official, mining, 1983 and joined rock engineering in 1985 as an observer.

2. Why did you choose Rock Engineering?

Did not have the "balls" to do mining and asked for a transfer to rock engineering.

3. Please tell us a bit more about your career journey?

Not a nice story to tell, but let me give it a shot. I was asked to leave the apprenticeship training facility at Anglovaal because of an argument with my trainer, Mr Murning. Fortunately, there was a vacancy for a mining learner official at Buffelsfontein Gold Mine, Gencor. Did not enjoy production and got into trouble for always arguing with my line management; was then transferred to the Rock Engineering Department, and have never looked back. Left Buffelsfontein Gold Mine in 1989 to join Vaal Reefs as an SCO, then joined Bafokeng South Platinum Mine (Impala Platinum) as a Rock Engineer and stayed with them until 1996, joined Rustenburg Platinum from June 1996 to December 1997, and then returned to Impala Platinum end of 1997. Was appointed as the Rock Engineering Manager for Impala in March 1999 and was appointed Group Rock Engineering Manager for Implats in 2008.

IMPLATS
Distinctly Platinum

4. In your opinion, what are some of the challenges that the fraternity is currently facing?

Firstly, a lot of people have passed their rock engineering certificate lately and have been pushed into rock engineering positions without having the necessary experience, but this is a South African problem and we see it happening in the mining fraternity as well. Secondly, the youngsters are getting involved with the setting of examinations and practical exams. I believe here we lose a lot of the practical, hands-on issues that don't get mentored to the newer generation. We need to blame the older generation, as we don't want to get involved enough and it will be nice to see them getting more involved again. Thirdly, because the rock engineering fraternity is used by management, and to a small degree by the DMR, to act as "policemen" to measure compliance, it is now becoming the responsibility of the Rock Engineering Department to ensure compliance. Compliance needs to stay the responsibility of line management.

5. What are some areas that you believe will become of increasing importance in the near future for the rock engineering discipline?

Historically, Rock Engineering Departments were small, but are getting larger and one will need to learn the skills to work with people.

6. What advice would you offer people aspiring to be in your position?

Be honest with yourself and with management, and never shy away from telling the truth. It will at times cause consternation; remember, rock engineers will never win a popularity contest with line management.

"Surround yourself with people with different skills and people you can trust."

7. Who is your role model/mentor?

I have been very fortunate to have worked with great leaders in the rock engineering field. The first to come to mind is Roger More-O-Farrell: he was phenomenal with the rock engineering principles and he had the ability to surround himself with strong rock engineers who understood mining, as well as rock engineering. In mining, I worked for Senior Managers who were outstanding in their jobs, such as John Smithies and Pieter Anderson, but I must mention Mr Paul Visser who helped develop my management skills on how to get the job done and to trust the people working with me. Lastly, Tinus Gericke has brought back the passion for the "job".

8. What is the best advice you have ever been given?

The best advice I have ever been given was "Surround yourself with people with different skills and people you can trust". I have been blessed to be surrounded with great, hardworking people, many of whom have better skills than I have.

9. Who has influenced my life the most?

It might sound cliché, but my wife Anrea has really turned my life around, and taught me to be more patient and caring. My team will testify to that; they say I have changed a lot, and for the better. My daughters, they keep my feet on the ground, ready to tell me if I have messed things up.

IMPLATS
Distinctly Platinum

ROCK STAR OF THE QUARTER

Full Name: Andreas (Andre) Petrus Esterhuizen

Position: Rock Engineering Manager – Eastern Bushveld

Company/Organisations: I am employed by Open House Management Solutions, and I am a member of SANIRE and SAIMM

Date and Place of Birth: I was born in Klerksdorp on 14 April 1981

Education: After a brief stint at university, I obtained my COM Strata Control and Rock Engineering Certificates. Following that, I obtained an Advanced Rock Engineering Certificate.

First Job: Computer programmer for a company focused on modernising the agricultural sector.

Personal Best Achievement/s: Professionally: to date, the quality and success of the rock engineering function at Two Rivers Platinum mine, which has since become leading practice, is something that I am very proud off. As with everything, I can't take all the credit for the success of the system, but I played a large part in the early development. Personally, I hold black belts in three different styles of Karate and have represented South Africa internationally.

Favourite Food/Drink: I love shepherd's pie and pasta, and a good red wine.

Favourite Sport: I am an avid Sharks rugby supporter, and enjoy boxing and all forms of martial arts.

'Never present problems without solutions.'

1. How did your career in the mining industry begin and where are you now?

I started off working in the Seismology Department at Harties in 2001, which lasted for 8 months. The following year I transferred to the Rock Engineering Department and obtained my SCO ticket. I was transferred to Two Rivers Platinum near Lydenburg in 2005, where I obtained my Rock Engineering Certificate and AREC. I am currently managing the largest department (by number of employee) within OHMS, and I am responsible for on-site contractual, as well as consulting, services for mines situated within Mpumalanga, Limpopo and, most recently, also Zambia.

2. Why did you choose Rock Engineering?

What attracted me most in the beginning of my career was the opportunity to work in a young, developing field of science. I love to read and research just about anything in an effort to continually better myself and my general knowledge, and this field suited my personality perfectly. There are no quick fixes; in order to be successful you must have a passion for understanding what you see around you, and aim to find practical solutions to real problems.

3. Please tell us a bit more about your career journey?

I started off in OHMS's Seismology Department as a Seismic Processor at Harties. During this period I was exposed to, and became interested in, Rock Engineering, as both departments were managed by our company. When a vacancy opened up in the Rock Engineering Department, I requested to be transferred and became a Learner Strata Control Officer. I obtained my SCO ticket 4 months later. After that, I was transferred to the Eastern Bushveld where I matured into a qualified Rock Engineering Manager. I have been very fortunate in my career to date to be associated with fantastic Rock Engineers and Mine Managers who have had significant influences on my career.

OHMS

Philosophy of Life:

The saying "You don't find yourself, you create yourself" comes to mind. I firmly believe that we are not born for a specific purpose, but that our lives obtain meaning through what we do and how we affect the world and those around us.

4. In your opinion, what are some of the challenges that the fraternity is currently facing?

The level of competence within the fraternity is definitely increasing and we are producing competent engineers. However, I recently became aware of the fact that most rock engineers have very limited exposure. Whilst they might be experts on their specific mines and environments, they falter as soon as their environments change. This leads to complacency and stagnation. I am a very much in favour of a system whereby all qualified rock engineers are required to refresh their qualification on a set and regular basis.

On the flip side, the level of competence in the mining industry – especially on the production front – is decreasing rapidly. This results in rock engineers spending more time on policing, and less time on actual design work, which obviously influences job satisfaction.

5. What are some areas that you believe will become of increasing importance in the near future for the rock engineering discipline?

As mining continues to advance deeper and deeper, we need to obtain a better understanding of rock mass behaviour to stress. Stable pillar design also has much room for improvement. As a gadget lover, I would love to see more research on, and the introduction of more, electronic technologies, such as digital image processing, pattern recognition and more sophisticated means of measurement.

6. What advice would you offer people aspiring to be in your position?

Unfortunately, there are no shortcuts. Work hard, be meticulous, and be interested in what you do. My three favourite quotes are:

You are the product of your environment, so choose carefully the environment that will best develop you toward your objective.

Never present problems without solutions.

You don't always get what you deserve, but you always get what you work for.

7. Who is your role model/ mentor?

I have many role models. There are many of my friends, family members, colleges and even subordinates that I look up to and whose opinion I regard very highly.

My mentor, and without doubt the largest influence in my professional career, is Koos Bosman, who has instilled in me a deep love of rock engineering, research, knowledge, and red wine.

8. What is the best advice you have ever been given?

"Distinguish between what is important and what is urgent", and my favourite: "Own your mistakes, and then move on".

TECHNICAL CORNER

Note on the estimation of joint shear strength for JBlock

William Joughin

SRK Consulting

Although this article is focused on the calculation of joint shear strengths for use in JBlock to evaluate underground rockfalls, it contains information relevant to anybody calculating joint shear strengths, in any rock engineering environment.

When designing support in JBlock, it is important to investigate the joint characteristics in a Ground Control District (GCD). Each joint set within a GCD could present a range of joint conditions from rough undulating joints with no fill, to slickensided joints with thick soft clay infill such as serpentinite. The joint shear strength will therefore be variable and will significantly affect the stability of blocks formed. It is important to capture the distribution of shear strengths in JBlock so that the analysis is representative of the GCD on which it is based.

JBlock can create a few hundred thousand blocks and then test their stability within a supported excavation. Each block is formed by combining joints from the different joint sets. The attributes of these joints (dip, dip direction, persistence and shear strength) are selected by a randomly sampling from the input distributions. The user can specify the mean and standard deviation or the minimum and maxim for each joint characteristic.

JBlock uses the classic Mohr-Coulomb model for determining joint shear strengths:

$$\tau = c + \sigma_n tan\phi$$

where c is the cohesion and ϕ is the friction angle of the joint.

For each joint set, JBlock requires the mean and standard deviation of c and ϕ. These are randomly applied to individual joints using a normal distribution (at this time no other distributions are availible). It is important to input a representative distribution of joint shear strengths, but it is not critical to accurately determine the shear strengths of individual joints.

Unfilled joints have no real cohesion. Uncemented, coarse joint fill material and gouge, also have no cohesion. Soft clay infills have very low cohesion and this can generally be ignored, but it may be prudent to carry out laboratory shear strength tests on these joints. If the laboratory cohesions are used, it may be sensible to make these a separate joint set (note that the joint spacing parameters should be determined for the filled joint set and not for all similarly oriented discontinuities). Quartz and calcite veins are effectively cemented and therefore have high cohesion values. If these veins commonly form bounding discontinuities in the observed rockfalls, they should be included as a separate joint set. The shear strengths of closed veins should be determined in a laboratory. Rocklab has the facilities to perform shear strength tests on natural joints. However, it is usually reasonable to ignore veins and not to use cohesion for filled joints, but this should be verified in each GCD.

Nick Barton and his colleagues have performed many hundreds of rigorous laboratory and field tests on discontinuities in rock and have published many papers on the subject. They have proposed methods for estimating the shear strength of discontinuities in the field without having to use the cumbersome tests. This work is widely used and accepted by the rock engineering fraternity internationally and appears in most rock mechanics textbooks. A few important papers are included in the references (Barton, 1973; Barton and Choubey, 1977; Barton and Bandis, 1990; Barton, 2002).

It is recommended that the following simple formula is used to estimate friction angles from data collected during a routine joint mapping exercise:

$$\phi = tan^{-1}(Jr/Ja)$$

where Jr and Ja are the join roughness and joint alteration used in Barton's Q system (Barton, 2002).

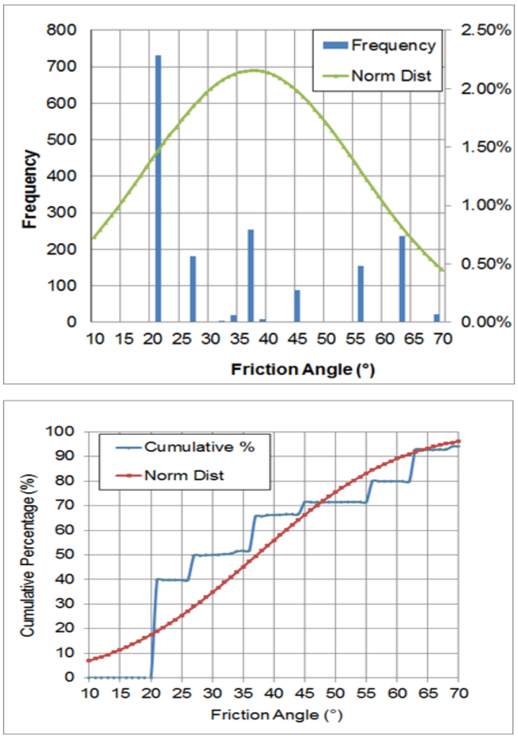


Figure 1: Frequency and cumulative frequency distributions of friction angle.

Barton considers this to be good estimate of the friction angle for joints with rockwall contact and is the only method for estimating the shear strength of filled discontinuities (Barton and Bandis, 1990, Barton, 2002 and Barton pers comm 2014).

This method is demonstrated in Table 1 where example friction angles are provided for different combinations of Jr and Ja. These parameters can be estimated using Table 2 and can be easily determined during underground mapping. The distinction between joints with rockwall contact, sheared joints with rockwall contact and no rockwall contact when sheared is illustrated. It is apparent that the strengthening effect of asperities

(rough undulations) is diminished with the presence of soft clay infills. The low friction angles for filled joints were assessed by Barton (1973) and results are presented in Table 3. Joints with thick serpentinised or soft clay fill could have friction angles of less than 10°.
This simple method is recommended because it provides reasonable estimates to obtain a distribution of friction angles for a joint set. Figure 1 is an example of joint set friction angle distributions.

It is apparent that the data contains a few discrete values of Jr/Ja, which is to be expected when using the Q tables (Table 2). There are some weak joints in this set, representing a thin fill, but no thick filled joints (lowest friction angle is 20°). The normal distribution smoothes the irregularities, but unfortunately does not provide a good fit to the data. A lognormal or beta distribution would provide a better fit, because of the large number of 20° friction angles, but these distributions are not currently available in JBlock. This enhancement to JBlock has been suggested and will hopefully become available in the near future.

It is also important to place upper and lower limits on the distribution; otherwise the random sampling process will assign negative friction angles and friction angles greater than 90° to a few individual joints, which will lead to errors. The lower limit should be slightly lower than the lowest estimated friction angle, but not less than 2°. It is recommended that the upper limit should be 70° or less. Barton does not appear to be uncomfortable with friction angles greater than 70°, but Hoek suggests that ϕ values greater than 70° have no practical meaning.

Barton (Barton and Choubey, 1977 and Barton and Bandis, 1990) also proposed the more rigorous Barton-Bandis model for determining the shear strength of **unfilled discontinuities with rock wall contact**. (Hoek provides a good summary of this method):

$$\tau = \tan\{\phi_r + JRC \log_{10}(JCS/\sigma_n)\}$$

Where *JRC and JCS* are the Joint roughness coefficient and Joint compressive strength respectively and Φ_r is the residual friction angle, which can be determined as follows:

$$\phi_r = (\phi_b - 20) + 20(r/R)$$

Where *r* is the Schmidt rebound number for wet and weathered fracture surfaces and *R* is the Schmidt rebound number on dry unweathered sawn surfaces. ϕ_b is the basic friction angle, which can be determined from literature or preferably by a laboratory shear test. Note that for a dry unweathered joint, $\phi_r = \phi_b$.

JCS can be estimated from the profiles in Table 4. Suggested methods for estimating the joint wall compressive strength were published by the ISRM (1978). The Schmidt rebound hammer can be used for estimating joint wall compressive strength.

A further scale correction is usually required, as this method is based on test samples and observations taken over approximately 10 cm, where rockfalls and failures can occur over several metres. This correction reduces the JRC and JCS and is based on the principal that a small asperity will have a lower effect on the shear strength of a 20 m long joint, than a 1 m joint.

This method requires considerably more effort and although it is a more rigorous estimation of joint shear strength for specifically unfilled joints with rock wall contact, it has some drawbacks when being applied in JBlock.

Firstly, additional work is required to convert the results to *c* and ϕ, the input parameters required by Jblock. It is a non-linear equation and therefore c_i and ϕ_i will vary for different values of σ_n (Figure 2). The c_i value is not the physical cohesion value but simply the intercept on the τ axis. Hoek provides a spreadsheet based calculation method for conversion to c_i and ϕ_i for a given σ_n, which is commonly used for joint analysis software that does not include the Barton-Bandis model directly. In the JBlock analysis, the magnitude of σ_n will vary for individual joints depending on the joint orientation and *c* and ϕ, up to a maximum of the set clamping stress in JBlock (for vertical joints). It should also be noted that for $\sigma_n = 0$, the model is undefined due to division by zero. The possibility of including the Barton-Bandis model in JBlock has been suggested and this may be available in the near future. This conversion will no longer be required if this is implemented.

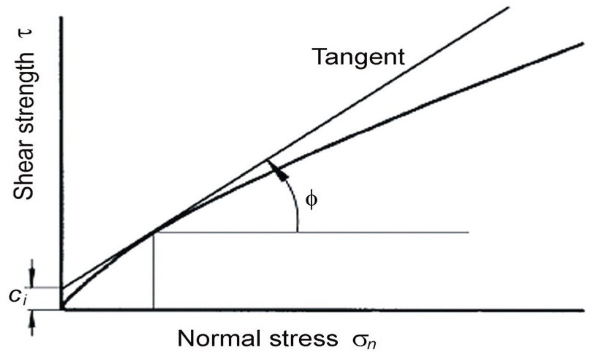
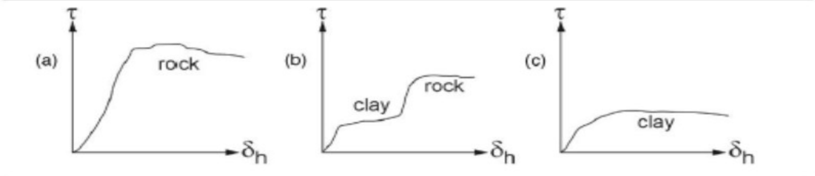


Figure 2: Definition of instantaneous cohesion c_i and instantaneous friction angle Φ_i for a nonlinear failure criterion (after Hoek)

Secondly, the shear strength of filled discontinuities cannot be determined with this method. Barton specifically states that the method does not apply to filled discontinuities (Barton and Choubey, 1977 and Barton and Bandis, 1990, Barton pers comm 2014). The filled joints are the weakest and are therefore more likely to cause rockfalls. It is therefore recommended that this approach should only be used when there are no filled or sheared joints in the set.

Continued..........

Table 1: Estimation of joint friction angle (from Barton, 2002)



(a) Rock wall contact	J_r	(thin coatings) J_a/J_r = 0.75	1.0	2	3	4
		$\tan^{-1}(J_r/J_a)°$				
A. Discontinuous joints	4	79°	76°	63°	53°	45°
B. Rough, undulating	3	76°	72°	56°	45°	37°
C. Smooth, undulating	2	69°	63°	45°	34°	27°
D. Slickensided, undulating	1.5	63°	56°	37°	27°	21°
E. Rough, planar	1.5	63°	56°	37°	27°	21°
F. Smooth, planar	1.0	53°	45°	27°	18°	14°
G. Slickensided, planar	0.5	34°	27°	14°	9.5°	7.1°

(b) Rock wall contact when sheared	J_r	(thin fillings) J_a/J_r = 4	6	8	12
		$\tan^{-1}(J_r/J_a)°$			
A. Discontinuous joints	4	45°	34°	27°	18°
B. Rough, undulating	3	37°	27°	21°	14°
C. Smooth, undulating	2	27°	18°	14°	9.5°
D. Slickensided, undulating	1.5	21°	14°	11°	7.1°
E. Rough, planar	1.5	21°	14°	11°	7.1°
F. Smooth, planar	1.0	14°	9.5°	7.1°	4.7°
G. Slickensided, planar	0.5	7°	4.7°	3.6°	2.4°

(c) No rock wall contact when sheared	J_r	(thick fillings) J_a/J_r = 5	6	8	12	13	16	20
		$\tan^{-1}(J_r/J_a)°$						
Nominal roughness of discontinuity rock walls	1.0	11.3°	9.5°	7.1°	4.8°	4.4°	3.6°	2.9°

Table 2: Q parameters Jr and Ja (Barton, 2002)

Table A3

Joint roughness number		J_r
(a) *Rock-wall contact, and (b) rock-wall contact before 10 cm sear*		
A	Discontinuous joints	4
B	Rough or irregular, undulating	3
C	Smooth, undulating	2
D	Slickensided, undulating	1.5
E	Rough or irregular, planar	1.5
F	Smooth, planar	1.0
G	Slickensided, planar	0.5
(b) *No rock-wall contact when sheared*		
H	Zone containing clay minerals thick enough to prevent rock-wall contact.	1.0
J	Sandy, gravely or crushed zone thick enough to prevent rock-wall contact	1.0

Notes: (i) Descriptions refer to small-scale features and intermediate scale features, in that order. (ii) Add 1.0 if the mean spacing of the relevant joint set is greater than 3 m. (iii) $J_r = 0.5$ can be used for planar, slickensided joints having lineations, provided the lineations are oriented for minimum strength. (iv) J_r and J_a classification is applied to the joint set or discontinuity that is least favourable for stability both from the point of view of orientation and shear resistance, τ(where $\tau \approx \sigma_n \tan^{-1}(J_r/J_a)$).

Table A4

Joint alteration number		ϕ_r approx. (deg)	J_a
(a) *Rock-wall contact (no mineral fillings, only coatings)*			
A	Tightly healed, hard, non-softening, impermeable filling, i.e., quartz or epidote	—	0.75
B	Unaltered joint walls, surface staining only	25–35	1.0
C	Slightly altered joint walls, non-softening mineral coatings, sandy particles, clay-free disintegrated rock, etc.	25–30	2.0
D	Silty- or sandy-clay coatings, small clay fraction (non-softening)	20–25	3.0
E	Softening or low friction clay mineral coatings, i.e., kaolinite or mica. Also chlorite, talc, gypsum, graphite, etc., and small quantities of swelling clays	8–16	4.0
(b) *Rock-wall contact before 10 cm shear (thin mineral fillings)*			
F	Sandy particles, clay-free disintegrated rock, etc.	25–30	4.0
G	Strongly over-consolidated non-softening clay mineral fillings (continuous, but <5mm thickness)	16–24	6.0
H	Medium or low over-consolidation, softening, clay mineral fillings (continuous, but <5mm thickness)	12–16	8.0
J	Swelling-clay fillings, i.e., montmorillonite (continuous, but <5mm thickness). Value of J_a depends on per cent of swelling clay-size particles, and access to water, etc.	6–12	8–12
(c) *No rock-wall contact when sheared (thick mineral fillings)*			
KLM	Zones or bands of disintegrated or crushed rock and clay (see G, H, J for description of clay condition)	6–24	6, 8, or 8–12
N	Zones or bands of silty- or sandy-clay, small clay fraction (non-softening)	—	5.0
OPR	Thick, continuous zones or bands of clay (see G, H, J for description of clay condition)	6–24	10, 13, or 13–20

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Barton papers can be obtained from www.nickbarton.com.

Barton, N.R. 1973. 'A review of the shear strength of filled discontinuities in rock.' *Norwegian Geotech. Inst. Publ. No 105*. Oslo: Norwegian Geotech. Inst.

Barton, N.R. and Choubey, V. 1977. 'The shear strength of rock joints in theory and practice.' *Rock Mech.* 10 (1-2); 1-54.

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Barton, N. R. 2002. 'Some new Q-value correlations to assist in site characterisation and tunnel design.' *International Journal of Rock Mechanics & Mining Sciences* 39 (2002); 185–216.

Hoek. *Rock Engineering* (Course Notes). www.rocscience.com.

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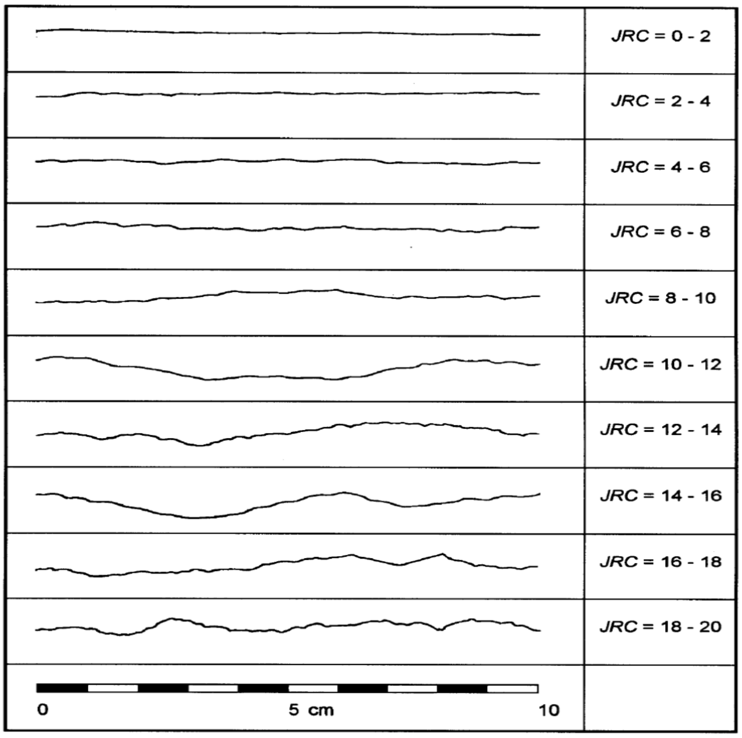
Table 3: Shear Strength of filled joints (as presented by Hoek – Data from Barton 1973)

Rock	Description	Peak c' (MPa)	Peak $\phi°$	Residual c' (MPa)	Residual $\phi°$
Basalt	Clayey basaltic breccia, wide variation from clay to basalt content	0.24	42		
Bentonite	Bentonite seam in chalk	0.015	7.5		
	Thin layers	0.09-0.12	12-17		
	Triaxial tests	0.06-0.1	9-13		
Bentonitic shale	Triaxial tests	0-0.27	8.5-29		
	Direct shear tests			0.03	8.5
Clays	Over-consolidated, slips, joints and minor shears	0-0.18	12-18.5	0-0.003	10.5-16
Clay shale	Triaxial tests	0.06	32		
	Stratification surfaces			0	19-25
Coal measure rocks	Clay mylonite seams, 10 to 25 mm	0.012	16	0	11-11.5
Dolomite	Altered shale bed, ± 150 mm thick	0.04	1(5)	0.02	17
Diorite, granodiorite and porphyry	Clay gouge (2% clay, PI = 17%)	0	26.5		
Granite	Clay filled faults	0-0.1	24-45		
	Sandy loam fault filling	0.05	40		
	Tectonic shear zone, schistose and broken granites, disintegrated rock and gouge	0.24	42		
Greywacke	1-2 mm clay in bedding planes			0	21
Limestone	6 mm clay layer			0	13
	10-20 mm clay fillings	0.1	13-14		
	<1 mm clay filling	0.05-0.2	17-21		
Limestone, marl and lignites	Interbedded lignite layers	0.08	38		
	Lignite/marl contact	0.1	10		
Limestone	Marlaceous joints, 20 mm thick	0	25	0	15-24
Lignite	Layer between lignite and clay	0.014-.03	15-17.5		
Montmorillonite	80 mm seams of bentonite (mont-morillonite) clay in chalk	0.36	14	0.08	11
Bentonite clay		0.016-.02	7.5-11.5		
Schists, quartzites and siliceous schists	100-15- mm thick clay filling	0.03-0.08	32		
	Stratification with thin clay	0.61-0.74	41		
	Stratification with thick clay	0.38	31		
Slates	Finely laminated and altered	0.05	33		
Quartz / kaolin / pyrolusite	Remoulded triaxial tests	0.042-.09	36-38		

JBlock is a user-friendly tool that is used for identification of key blocks and failure potential, based on a probabilistic analysis. Input parameters, such as orientation, size and strength estimates for joints, faults and the position of hangingwall parallel discontinuities, can be considered in the analysis. The results are useful input parameters in support design and for identification of fall of ground hazards. JBlock provides results in the format of plans and charts of the probability of failure of key blocks of different sizes. The results can be compared qualitatively with calculations from numerical modelling software and rock mass ratings.

Table 4: JRC profiles (after Barton and Choubey, 1977, as presented in Hoek)



srk consulting

Lets go invent tomorrow instead of worrying about what happened yesterday.

Steve Jobs

TECHNICAL CHALLENGE

Lagrangian
Flac
Udec
Map3d
Minsim
Analytical
Finite
Distinct
Discontinuity
Element
Boundary
Integral

Numerical Modelling

D	R	J	B	F	E	I	T	E	A	L	L	B	G	U
M	I	N	S	I	M	N	Y	N	T	A	P	I	D	R
S	L	S	V	O	E	I	A	W	T	R	E	E	M	Q
E	F	F	C	M	Y	L	P	A	M	G	C	Q	O	K
O	U	I	E	O	Y	R	A	Q	K	E	S	A	T	A
H	B	L	N	T	N	J	A	I	L	T	X	E	L	W
V	E	U	I	I	Q	T	I	D	F	N	T	Q	A	T
V	T	C	N	I	T	S	I	D	N	I	J	R	G	N
F	A	L	D	H	Y	E	L	N	V	U	G	A	R	Q
L	B	P	I	V	H	L	F	I	U	X	O	R	A	L
X	M	I	P	I	T	B	H	B	P	I	V	B	N	Z
W	N	D	A	H	C	B	O	W	V	W	T	K	G	F
S	G	V	K	Q	E	C	M	A	M	D	X	Y	I	L
K	R	C	T	Y	C	R	L	O	I	D	Y	U	A	A
Q	L	T	L	U	Y	M	Z	I	A	L	R	R	N	C

TECH NEWS

'Technology transfer on minimising seismic risk in the platinum mines'

We are pleased to announce the launch of SIMRAC project SIM140301, entitled 'Technology transfer on minimising seismic risk in the platinum mines'. The project was awarded to SiM and collaborating agencies (Middindi Consulting) to create training materials for both production and rock engineering personnel on mines and to conduct basic audits of mine seismic systems.

The training programme and audits will be based on the guidelines produced by SIM100301, 'Minimising the increasing seismic risk in the platinum sector', completed in 2011. This two-year project is designed to produce the following main deliverables:

1. State-of-the-art, animated learning materials for production personnel with subsequent roll-out of training at mine facilities.

2. Sourcing and compiling of training materials for rock engineering personnel and their distribution to mines.

3. Development of an audit protocol for seismic monitoring and reporting, followed by once-off audits per business unit on each PGM producer.

All stakeholders who wish to contribute or to benefit from this project are hereby invited to join. The project plan provides opportunities to collaborate and to facilitate training initiatives across the Western and Eastern Bushveld regions. Mining operations, state departments, labour unions, practitioners and researchers in the field of rock engineering and training are encouraged to join this programme.

TECH NEWS

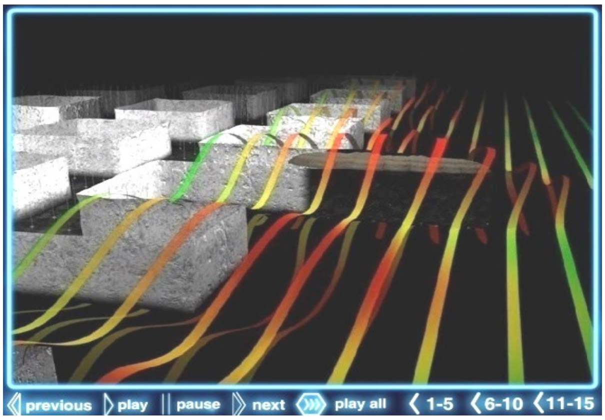
‘Technology transfer on minimising seismic risk in the platinum mines’

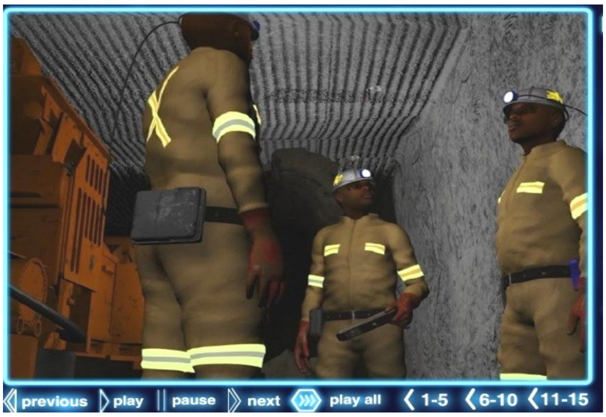
In July 2011, the SIMRAC project SIM100301, ‘Minimising the increasing seismic risk in the platinum sector’, was successfully completed. The main authors of this project were SiM Mining Consultants on seismology and Middindi Consultants on rock engineering.

SIM100301 looked at the causes of seismic conditions and the implications which these held for mine design and practice on platinum mines. It also evaluated the performance of routine seismic hazard assessment methods and compared recommended to actual seismic monitoring practice.

SIM100301 suggested methods to improve mining practice, the effective gathering of rock mass related information, suitable seismic monitoring procedures, and training initiatives which should focus on conditions that generate seismicity in platinum mines.

Acting on a recommendation by the COM’s RETC committee, the MHSC issued a tender in June 2014. Recently, SIM 140301, a two-year technology transfer project, was awarded to SiM Mining Consultants, in collaboration with Middindi Consulting and Simulated Training Solutions (STS).





“Horizontal stress in coal mines”, ©2012 Coaltech

SIM 1403021 ‘Technology transfer on minimising seismic risk in the platinum mines’ aims to deliver on the SIM100301 recommendations in three ways:

Creating learning and awareness training material for production personnel on PGM mines to improve seismic risk management, and assisting with the roll-out of this training;

Sourcing and revising relevant seismic training material for Rock Engineers for all commodities; and

Developing an audit protocol for seismic systems and conducting a baseline audit on each PGM producer.

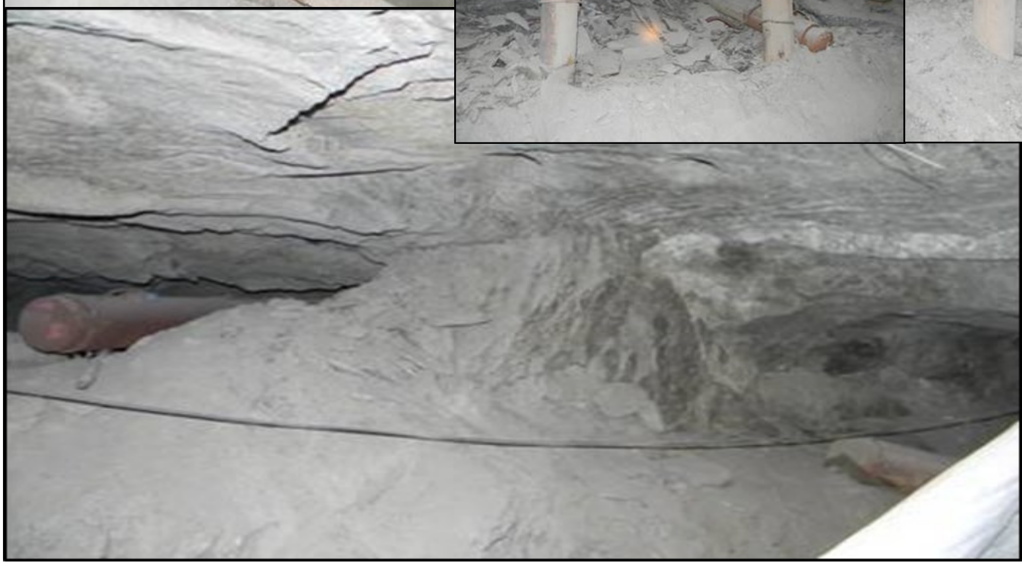
The training materials for production personnel aim to use advanced and innovative technologies, supplied by STS, to provide a virtual reality learning environment that can be better understood by a workforce not overly familiar with English. The materials will be workable in the most common current training facility setups and trainers will be able to choose the most relevant sections, from modules, to integrate with existing training. Trainers can attend one of several workshops to familiarise themselves with the new material.

The training material for Rock Engineers already exists in various formats and this phase of the project will focus on collation, revision and distribution.

Continued……..

The audit protocol will be built on the guidelines provided in SIM100301, but will have to cater for a range of different seismic system setups: from shafts monitored by a single surface site, to those with more than ten stations. The stakeholder interest shown in a baseline audit (nine mines have indicated active support) shows the relevance and necessity of practice reviews. Most operations do not include seismic system audits in their budgets and this project will be delivering a valuable service to a number of operations. Individual audit reports will be compiled per business unit, as well as a summarising report reflecting all business units. The summary will contain statistics on equipment deployed, practices implemented, level of compliance, and gaps evident between recommended and actual standard of seismic monitoring and reporting.

Invitations to participate were sent out in November to all stakeholders. The success of SIM140301 relies on the active support and participation by each producer, for the mutual benefit of the industry.



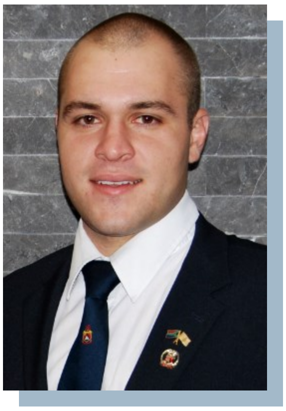
Seismic Movement: *A scalar that measures the co-siesmic inelastic deformation at the source. Since seismic movement in is proportional to the integral of the far field displacement pulse, it can easily be derived from recorded waveforms.*

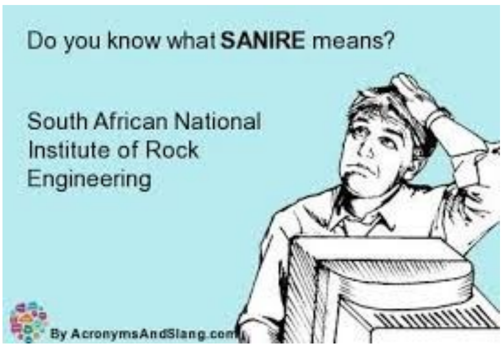
EDITORS CORNER

This is your newsletter and I would like to hear from you.

If you have any information or stories that we can use, please submit them via email to

paul.couto@norplats.co.za or paul.coutopm@gmail.com





ROCK - ED

GUIDELINES FOR THE COM STRATA CONTROL CERTIFICATE PRACTICAL ASSESSMENT

Purpose:

The purpose of the assessment is "to assess" the candidate's ability to practise as an strata control officer.

Frequency:

The practical assessment will take place twice per year, in order to be synchronised with the written examinations. Candidates can only participate in one examination per examination cycle.

Process and Time Line:

The assessment coordinator will publish the assessment dates (and associated timeline) as soon as possible after examination results are released. Assessments are done by each company/mining group, independently.

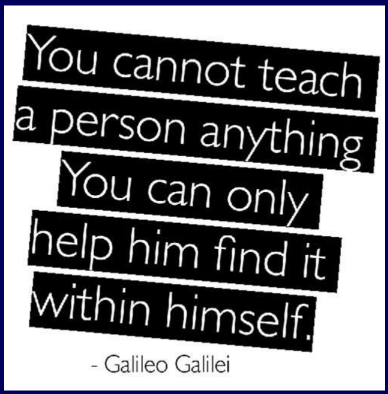
Registration:

To register, candidates must submit the Application form (Appendix 1). The COM Examinations office will provide the candidate with confirmation of registration. This proof of registration needs to be submitted to the assessment coordinator on the day of the assessment. If candidates do not register through the COM Examination Office, the candidate will not be allowed to participate in the practical assessment and submit his/her name to the relevant practical assessment coordinator. Candidates have to be in the possession of the theory part before attempting the practical assessment.

Competencies assessed:

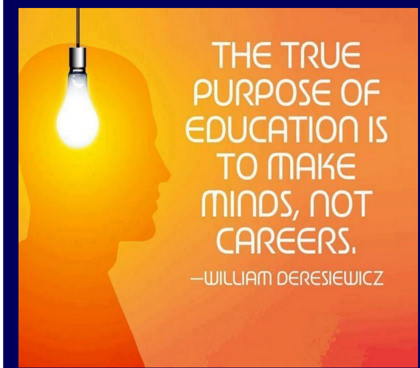
The intent of the assessment is for the candidate's professional peers to evaluate the following competencies:

- Mine plans – Plan interpretation
- Identify the plan symbols which are used on your mine.
- Explain the coordinate system used on your mine
- Plot offset measurements on mine plans
- Draw sections through mine plans to show changes in elevation of seams and effects of geological structures, such as faults or dykes.
- Transfer information between plans of different scales.
- Determine the mean dip and strike of a seam using peg elevations on mine plans.
- Locate yourself and determine orientations in underground workings using mine plans.
- Examine stope plans and identify deviations from prescribed shapes.
- Examine stope plans and identify potential rock-related problems due to face shapes or geological structures.
- Stope stability – Underground inspection of stope excavations
- Note the position of boxholes, gullies, travelling ways and crosscut intersections in stopes.
- Identify dangerous roof conditions, brows, slips and faults and indicate what support is required according to the mine codes of practice.
- Identify rolls, faults, dykes and folds and transfer this information to mine plans.
- Make use of stope plans to check whether pillars and face shapes are correct.
- Identify stope fracturing and major joint sets.
- Identify the causes of falls of ground.



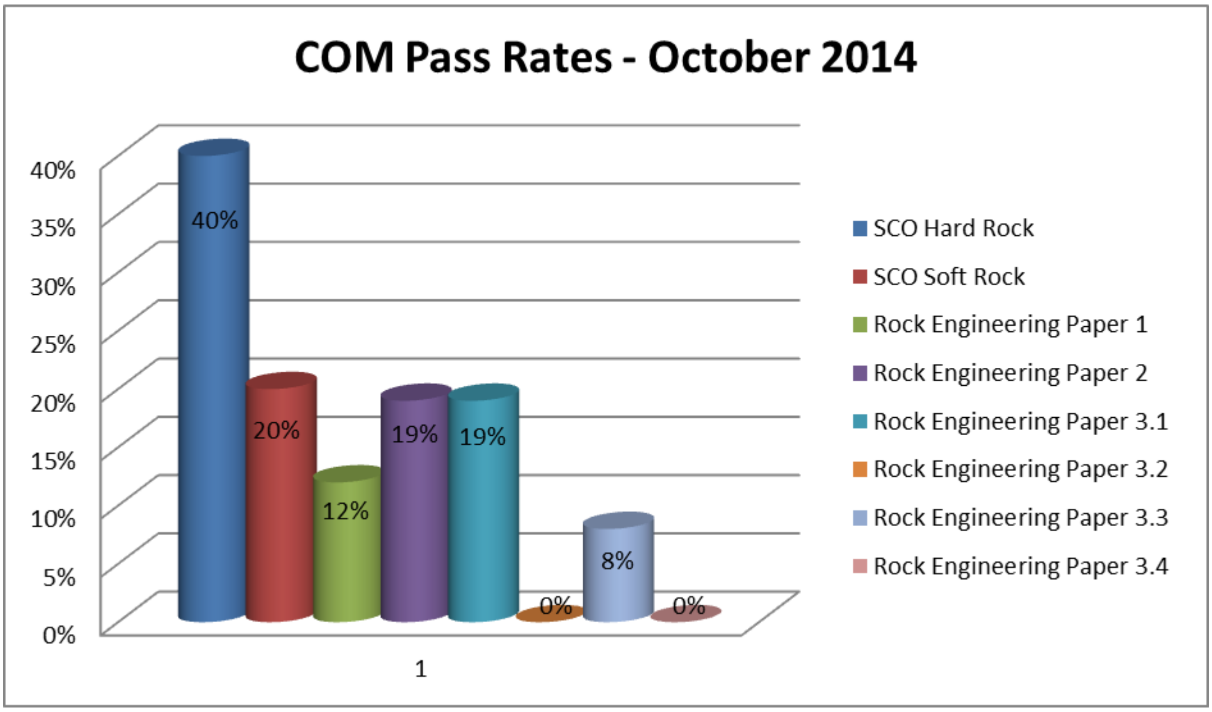
An application form will also need to be completed before any candidate can register for the examination. This registration form requires a referral by a Rock Engineer. The Registration form can be obtained by download from the SANIRE website. For any further enquiries please contact Yolande Jooste.

Yolande.Jooste@Harmony.co.za



- Sketch and describe falls of ground in stopes.
- Stope Stability – Practical support installation in stopes.
- Demonstrate how stope support types used on your mine should be installed.
- Demonstrate how temporary supports should be safely removed.
- Assess installed stope and gully support and recommend remedial measures if inadequate.
- Assess the performance of pillars in stopes.
- Recommend additional support in poor or dangerous ground conditions where mine standards are inadequate.
- Tunnel stability – Inspection of tunnel excavations.
- Identify stress fracture patterns and major joint sets in tunnels.
- Identify faults and dykes and transfer this information to mine plans.
- Identify dangerous brows or friable, blocky ground that requires additional support.
- Identify blast fractures and barrels of blast holes.
- Sketch and describe falls of ground in tunnels.
- Tunnel stability – Practical installation of tunnel support.
- Indicate the correct location and orientation of support for tunnels and for breakaways.
- Identify departures from recommended support.
- Identify difficulties which may have necessitated departures from recommended support.
- Demonstrate the correct installation procedure of support types used in your mine.
- Identify poor installation of support and recommend remedial measures.
- Recommend additional support in situations where mine standards are inadequate.
- Identify failed support and the mode of failure.
- Practical geology.
- Identify samples of the main rock types found on your mine and classify them as sedimentary, igneous or metamorphic.
- Identify the main rock types in underground workings.
- Point out weak layers or other important horizons in underground workings.
- Monitoring.
- Install monitoring equipment used on your mine.
- Take measurements on monitoring equipment used on your

COM Results

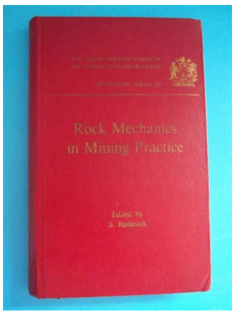


GOODBYE TO A LEGEND…………

It is with great sadness that we inform you that Professor Alex (S) Budavari passed away on the 30th of December 2014.

Professor Budavari was born on 1 January 1930 and was a postgraduate student at the University of Sopron at the time when he fled Hungary in 1956. After periods with the National Coal Board in the UK, the University of Newcastle-upon-Tyne and the University of New South Wales, he was appointed to the Chair of Rock Mechanics at Wits in 1974. He also served as the Head of the School of Mining Engineering at Wits from 1983 to 1985. Following his retirement at the end of 1990, he stayed on in post-retirement contracts and eventually as a part-time lecturer until he was 75 years old. Professor Budavari dedicated a large period of his life to teaching rock mechanics at Wits University, through which many of us benefited greatly. His teaching style was unique; always relating practical examples to the underlying theory, and his patience with non-graduates will be fondly remembered.

Professor Budavari was also the editor of the “red book”, titled *Rock Mechanics in Mining Practice*, which was published by the SAIMM.



ROCK QUIZ

Select the correct answers for the following three multiple choice questions and submit the answers to Paul Couto ***paul.couto@norplats.co.za*** before the 5th April 2015. The first three entries that have all the answers correct will receive a SANIRE promotional item.

KEEP CALM AND JOIN THE QUIZ

1. A gold mine ranges in depth between 2 500mbs to 3 250mbs. Would you consider this mining depth operation to be:

A. Shallow

B. Medium

C. Deep

D. Ultra deep

2. Which support unit is classified as passive active support:

A. Resin bolt

B. Cable tensioned anchor

C. Pack

D. Pre-stressed mine pole

3. RQD stands for:

A. Rock Quality Design

B. Rock Quality Designation

C. Rock Quantity Designation

D. Rock Quantity Design

SANIRE

SOUTH AFRICAN NATIONAL INSTITUTE OF ROCK ENGINEERING

Vision: To promote the interests of a vibrant South African Rock Engineering Fraternity

Mission: SANIRE promotes the advancement of the Rock Engineering discipline through the following objectives:

- Encouraging interest and the advancement of education in Rock Engineering
- Maintaining professional practice and high standards of ethics
- Encouraging networking; Collaboration and information exchange
- Identifying, promoting and facilitating rock engineering related research
- Providing access to the global rock engineering fraternity trough the ISRM.

Values:

- **Honesty**
- **Integrity**
- **Professionalism**
- **Accountability**
- **Transparency**

Contact Information:
Phone: 073 426 5180
E-mail: info@sanire.co.za
accounts@sanire.co.za

Postal Address
P. O. Box 463
Stilfontein
2551

www.sanire.co.za