SANIRE
SOUTH AFRICAN NATIONAL INSTITUTE OF ROCK ENGINEERING

ROCK talk

Volume 7, Issue 1 | April 2021

PRESIDENT'S CORNER

As we tackle 2021, following a devastatingly difficult year, the challenges that lie ahead are exciting yet daunting. 2021 not only brings hope, prospects and new opportunities, but also new challenges, which if not addressed timeously could result in missed opportunities.

The mining sector worldwide has entered a "supercycle" which could last between three to seven years, according to economists worldwide. The supercycle will be extremely beneficial to the South African mining industry, considering the fact that the exchange rate works in our favour. This could boost the recovery and possible growth of South Africa's bruised and scarred economy, following poor government decisions and the crippling effect of the COVID-19 pandemic.

WHAT'S **INSIDE**

PRESIDENT'S CORNER

There is an old saying of which my father regularly reminds me, which has become one of my principles:

"Son, make hay while the sun shines"

This short saying is something that we as an industry can now apply to the current supercycle. The large mining houses are reinvesting in new and existing projects in the country to grow their outputs and mining operations.

For you, as a professional in the mining field and a key role player ensuring the safe extraction of the minerals of the earth, there might be no better time to shine. The fast-paced expansion and growth of the industry will open up numerous development opportunities going forward. The time is now.

Let's not ignore the fact that not only will the industry grow, but our field will too, with new and upcoming professionals. All life cycles have an input and output and unfortunately, with the current economic crisis and the global demand and hunger for minerals, we will most probably lose skills not only to retirement but also to immigration.

As some SANIRE members stand down to rest after years of service or move on to new adventures in other lands, the time has come for ambitious new blood to excel and take the South African mining industry forward to the next level.

However, like all good things in life, these opportunities are not going to just fall in your lap; they will require tremendous willpower to harness our inner qualities and bring out the best professional from within. Let's start building a more united, focus-driven institute of professionals working together in harmony to help save the country. Now is our time to shine as the heroes who revived a country built on mining decades ago.

Paul Couto
President SANIRE

ISRM NEWS

The Italian Geotechnical Society (AGI) is delighted to announce that Turin will host the 2021 ISRM International Symposium from 20 to 25 September 2021. The AGI extends a warm invitation to mining practitioners to attend EUROCK 2021 Rock Mechanics and Rock Engineering from theory to practice.

As in previous years, the conference will consist of general and parallel sessions dealing with the most recent developments in rock mechanics, offering stimulating, fruitful technical and scientific interaction in the fields of rock mechanics, rock engineering and engineering geology. Last but not least, Turin, surrounded by the Alpine arc, is an ideal and attractive location to study rocks. To boot, the city boasts an impressive cultural heritage, a lively social and nightlife and the taste of Italian food and wine!

The programme includes workshops dedicated to innovative topics, keynote lectures by distinguished speakers and a series of technical visits. Delegates will be able to combine scientific topics with cultural, touristic and enogastronomic adventures.

Most of the parallel sessions will be opened with a theme lecture and continue with 9 to 11 presentations. Other papers will be presented in three poster sessions, each one lasting a whole day. Technical visits are scheduled from the closure of the Wednesday programme, while the gala dinner will be hosted on Tuesday night. More technical visits are planned for the days after the conference.

ISRM NEWS

The following topics will be addressed:

- Rock properties and testing methods
- Rock mass characterization
- Rock mechanics for heritage
- Rock mechanics and rock engineering for infrastructures
- Geophysics in rock mechanics
- Numerical medeling and back abalysis
- Nonlinear problems in rock mechanics
- Mining rock mechanics and rock engineering
- Design methods and analysis
- Monitoring and back analysis
- Underground excavationb and support
- Risk and hazard
- Petroleum engineering and hydrofracking
- Application of EUROCODE-7 in rock engineering

OTHER ISRM-SPONSORED EVENT DETAILS

Event title	Start date	End date	Country	City
9th International Symposium on Geomechanics - an ISRM Specialized Conference	2021-05-05	2021-05-06	Colombia	Virtual
5th Symposium of the Macedonian Association for Geotechnics - an ISRM Specialized Conference	2021-06-10	2021-06-12	Macedonia	Ohrid
5th International Workshop on Rock Mechanics and Engineering Geology in Volcanic Fields - an ISRM Specialized Conference	2021-09-09	2021-09-11	Japan	Fukuoka
EUROCK 2021 - Mechanics and Rock Engineering from Theory to Practice - the 2021 ISRM International Symposium	2021-09-20	2021-09-25	Italy	Torino
ARMS11 - 11th Asian Rock Mechanics Symposium, Challenges and Opportunities in Rock Mechanics - an ISRM Regional Symposium	2021-10-21	2021-10-25	China	Beijing
SBMR2020 - 9th Brazilian Rock Mechanics Symposium - an ISRM Specialized Conference	2022-08-23	2022-08-26	Brazil	Campinas
Eurock 2022 - Rock and Fracture Mechanics in Rock Engineering and Mining - an ISRM Regional Symposium	2022-09-12	2022-09-15	Finland	Helsinki
LARMS 2022 - IX Latin American Congress on Rock Mechanics, Rock Testing and Site Characterization - an ISRM International Symposium	2022-10-16	2022-10-19	Paraguay	Asuncion
6th Australasian Ground Control in Mining Conference – AusRock 2022 - an ISRM Regional Symposium	2022-11-29	2022-12-01	Australia	Melbourne
15th ISRM International Congress on Rock Mechanics	2023-10-09	2023-10-14	Austria	Salzburg

OBITUARIES

It is with great sadness that SANIRE remembers the passing of

Mr. Ben Kotze & Dr. Dennis Laubscher

Our hearths are saddened by your loss and our thoughts and prayers are with the family and colleagues.

May the precious memories of your loved one carry you through this difficult time

ROCK STAR OF THE QUARTER

Full Name:
Sifiso Comfort Mashile.
Position:
Senior Rock Engineer.
Company/Organisation:
Northam Platinum Zondereinde Mine.
Date and Place of Birth:
March 1990, Ermelo, Mpumalanga.
Education:
BTech in Mining Engineering.
First Job:
Learner Official, Anglo Platinum Mines, Rustenburg.
Philosophy of Life:
God helps those who help themselves.
Favourite Food/Drink:
Meat, just meat.
Favourite Sport:
Gymnastics/CrossFit.

Q. What is your biggest achievement to date – personal or professional?

Personally, every morning at 4 am when I kick the blankets to go hit the gym is the best achievement ever. Amongst numerous academic achievements, passing my Mining Engineering degree cum laude is top of the list.

Q. Where is your favourite place to eat?

Homemade meals are the best!

Q. What gets you out of bed in the morning?

Despite being content with where I am in life, I am still highly motivated by the goals and plans I have set for my future both professionally and personally and they are the reason I jump out of bed.

Q. Do you have a favourite quote?

"When you become comfortable with uncertainty, infinite possibilities open up in your life" – Eckhard Tolle

Q. What is the best vacation destination you've been to?

I love South Africa, especially the coastal areas. Thus far, Willard beach has been the best.

Q. What is your greatest fear?

I don't have a greatest fear. I always take life as it comes and fully accept the present moment. This doesn't necessarily mean that I don't experience the feeling of fear; but as soon as it arises, I let my being observe it and it soon dissolves in that presence.

Q. If you could interview one person (dead or alive) who would it be?

Prof Thomas (Dick) Stacey.

Q. If you could only drink one beer for the rest of your life, what would it be?

Windhoek draft.

Q. If you were stuck on an island, what three things would you bring?

My family, my family and my family.

Q. What do you find the most challenging aspect of rock engineering?

The stagnation in research and development in the fraternity, especially in South Africa.

Q. What do you like most about rock engineering?

The ever-present challenge of designing (making engineering-informed decisions) to ensure safe and economical extraction of mineral resources. This challenge just becomes more fascinating since I have to apply rock mechanics (engineering) principles to the deepest platinum mine in the world, the Northam Platinum Zondereinde Mine.

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

My mining career began back in 2008 when I was offered a bursary to study Mining Engineering by Anglo American Platinum. I was recruited for rock engineering. However, Anglo Platinum treated rock engineering and mining engineering trainees the same at the time. Hence, I was a mining learner official until I completed my studies and training programme. During my experiential training year, in 2009, I also studied for and passed my strata control theory exam. Moreover, in that same year, I managed to complete most of the blasting certificate modules. I completed my degree in 2011 and started working as a learner official in 2012. I got my full Strata Control ticket in early 2012 and I was then required to do six months of trial mining to obtain my permanent blasting certificate, which I completed. I was first appointed as a strata control officer in 2013 at Khomanani Mine (previously known as Frank Shafts). I got my full Rock Mechanics certificate in the same year, in 2013, with hard work and sheer determination. My supervisors at the time, Allan Olivier and Henry Chiwaye, gave me good mentoring and coaching. After obtaining my Rock Mechanics certificate, I worked for Modikwa platinum mine in the eastern limb and since late 2014 I have been working for Northam Platinum mine as a Senior Rock Engineer. I am currently studying towards a Master's in Mining Engineering at the University of the Witwatersrand (Wits).

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

I think research and development. More funding will have to be focused on these spheres. Furthermore, the research and funding will have to be well coordinated. The opportunities that will come with the fourth industrial revolution (4IR) will only be harnessed if the rock engineering fraternity – in fact, the South African mining industry in general – prepares for and embraces technologies like artificial intelligence (AI) and robotics, the Internet of Things (IoT), additive printing (3D printing), etc.

Q. Who is your role model/mentor?

When it comes to mentors, I source wisdom and knowledge from various people in my life. Throughout my entire mining career, I have been blessed with "bosses" that are actually leaders. My late dad is my role model.

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

You can do anything that you put your mind to (said by my dad).

WE ARE LOOKING FOR THE NEXT ROCKStar

NOMINATIONS ARE NOW OPEN

WE ARE SEARCHING FOR THE NEXT ROCK STAR WHO IS GOING ABOVE AND BEYOND

Please send us your nomination of who you would like to see interviewed in the next issue of ROCKtalk

PLEASE INCLUDE THE FOLLOWING IN YOUR NOMINATION

- ★ Name & Surname of Nominee
- ★ Mining Operation of Nominee
- ★ Designation of Nominee
- ★ Nominee's contact details
- ★ A short motivation as to why you have nominated the person

FOR FURTHER ENQUIRIES OR TO SUBMIT YOUR NOMINEE PLEASE SEND AN E-MAIL TO: info@sanire.co.za

The Rock Star award is given to up and coming younger-generation rock engineers (younger than 35). The award acknowledges the valuable work individuals are doing in their fields to improve systems, technologies, mining practices and applications. These candidates are making a name for themselves in the industry by their interventions and participation, as recognised by their peers and colleagues.

Typically, one award a year will be given to a deserving individual at the discretion of the SANIRE Council. The award, consisting of a certificate, trophy and a 1 oz silver Krugerrand, will be presented by the SANIRE President at the annual general meeting.

ANOTHER SUCCESSFUL EVENT

SAIEG and SANIRE recently hosted a successful hybrid event on slope stability, which attracted a large turnout of 121 attendees, in person as well as online. The first day of the seminar was chaired by SAIEG. Peter Terbrugge gave the keynote address. He joined SRK in May 1979, working closely with Dr Oskar Steffen on open pit slope stability. Peter spoke about the good, the bad and the ugly of open pits and shared some memorable moments. He also shared some great experiences and knowledge with the audience.

One of Peter's memorable moments; A state of the art prospecting drill rig found on site.

Another very interesting project described by Peter, where he was involved in designing the Koidu Vertical Pit.

The event covered a large range of topics and presenters. One of the speakers was from Thessaloniki in Greece and presented his discussion virtually.

The topics included:

- Climate change and slope stability
- SANRAL's slope management system
- Regional mapping of potentially unstable slopes
- Innovations in orientated slope and face mapping and stability assessment
- Slope modelling using remote sensing and object-based image analysis techniques
- Slope design philosophy
- Development of geotechnical models and slope management programs
- Portal and shaft boxcuts
- Use of discrete fracture networks for slope design
- Variably saturated fracture flow in rock slopes
- Probability and risk-based design

The seminar offered generous refreshments and enough time to network and enjoy the company of other delegates.

SANIRE would like to extend a word of appreciation to SAIEG for the arrangements and the sponsors making this event possible

Banners of the sponsors displayed at the conference.

Q&A session following a presentation.

WE ARE LOOKING FOR YOU

WE VALUE YOUR INPUT AND WE ARE CALLING ON OUR MEMBERS TO CONTRIBUTE CONTENT TO THE SANIRE NEWSLETTER

THIS IS AN OPEN INVITATION CALL FOR ARTICLES

If you are interested in submitting content for the next issue of ROCKtalk , please send us an email at info@sanire.co.za with your proposal along with a commitment date.

SUBMISSION CATEGORIES

- Industry Related Articles
- Academic Papers
- Case Studies

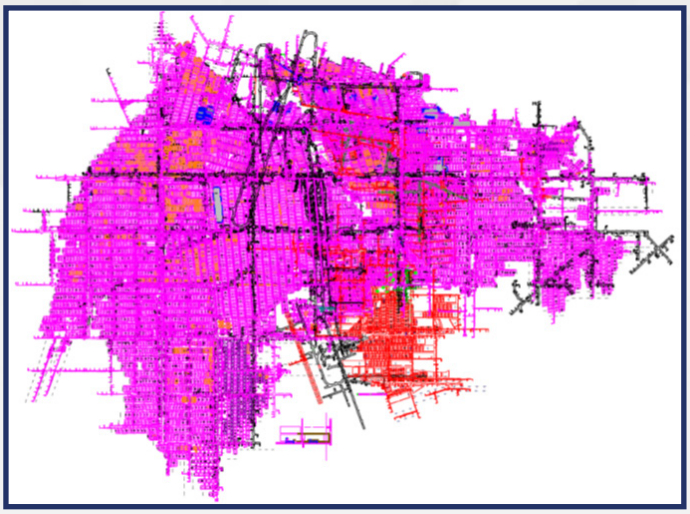
SUBMIT AN ARTICLE AND STAND A CHANCE OF WINNING

SANIRE MEMORABILIA

FOR FURTHER ENQUIRIES OR TO SUBMIT YOUR PROPOSAL PLEASE SEND AN E-MAIL TO: info@sanire.co.za

INNOVATIONS IN PILLAR MINING

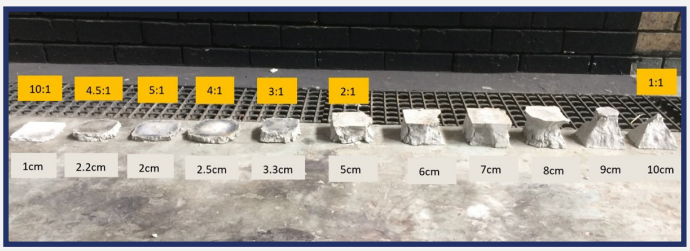
Gold 1, Modder East operations, is a gold mine situated 40 km east of Johannesburg. The mine exploits the Buckshot Pyrite Leader Reef Zone (BPLZ) and the Upper Kimberley Reef (UK9) at approximately 320 m below surface. The dip of the BPLZ reef is virtually flat, while the UK9 reef dips between 5 and 9°. Conventional breast mining is employed on the mine. The stoping width ranges from 1 to 11 m. The standard breast panel sizes are in the region of 25 m, with pillars of 4 to 6 m wide by 8 m long. Where the reef package is more than 3 m, the reef is extracted employing a bord-and-pillar mining method. The stoping width in the bord-and-pillar section is generally 5 m high. Where the reef package is payable, secondary footwall extraction is done up to 11 m high.



Plan view of the mining operations

The BPLZ hanging wall is a very competent Black Reef Quartzite. The uniaxial compressive strength of the hanging wall quartzite is approximately 400 MPa. The uniaxial compressive strength of the reef and footwall is between 180 and 220 MPa. The RMR89 system was used, while an RMR rating of 82 on Modder East was categorised as very good. The stability of the mine was not heavily influenced by geological structures.

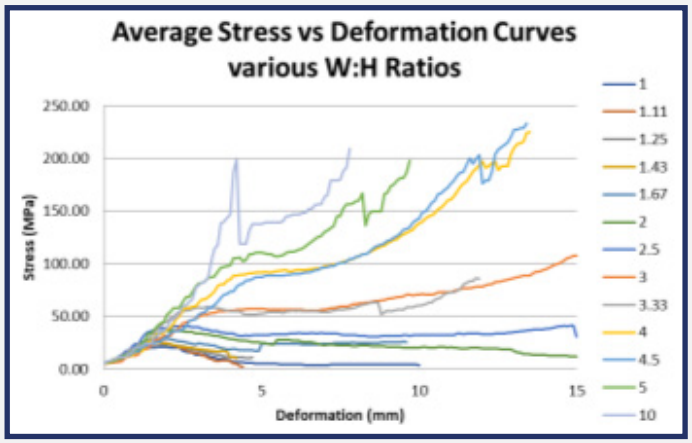
The pillars on Modder East are designed to be non-yield pillars with a 1,6 factor of safety. The Hedley and Grant tributary area theory has been used to calculate the factor of safety of the pillars.



Scale tests conducted on concrete

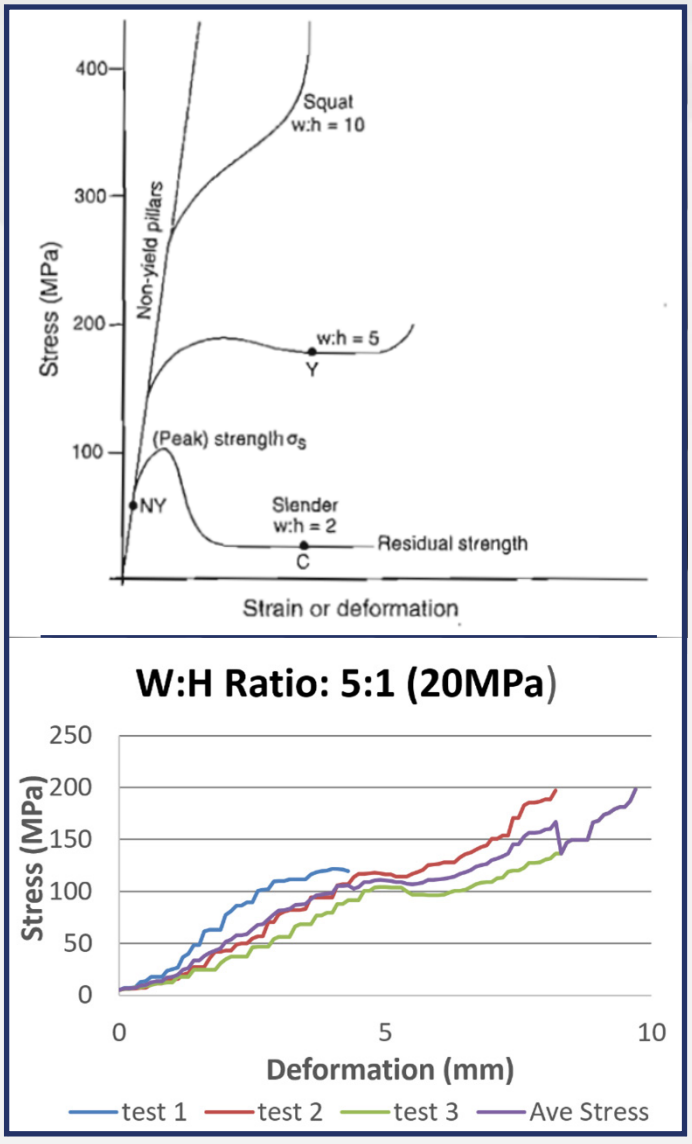
The pillar-mining design is based on the notion that the support medium that replaces the pillars should replace the design function of the hard-rock pillar that will be mined. As Modder East employs non-yielding pillars that are designed to support the overburden weight up to the surface, the support medium used to replace the pillars should also be capable of supporting the overburden weight up to the surface whilst not allowing excessive closure. Concrete samples with various width:height ratios were tested in a 2 000 kN press to determine whether the squat pillar effect applies to concrete as to underground hard-rock pillars. The test results indicated that there was a direct correlation between the samples tested in the press and the behaviour of squat pillars underground. A total of 63 concrete sample tests were conducted, using different material strengths and compositions. The test revealed a trend where concrete samples increased in strength as their width:height ratios increased relative to their material strengths. This trend could be mathematically expressed with a standard deviation of 5,0 MPa.

The samples were tested with 1 cm interval heights from 1 to 10 cm to test the effect that different width:height ratios had on the concrete samples. Stress-Deformation curves it can be seen that as the sample height decreases, the size of the intact core of the sample increases after failure. The results prove that the squat-pillar effect is applicable to concrete as well as hard-rock pillars.



From the stress-deformation curves of 20MPa concrete the peak strength of a 20 MPa concrete sample with a width:height ratio of 5:1 is approximately 100 MPa. After the sample reaches its peak strength, there is some strain-softening or plastic behaviour of the sample after it exerts strain-hardening properties that resist stresses beyond the material strength and the sample peak strength. This correlates well with the stress:strain behaviour of hard-rock squat pillars. The samples that were tested showed that samples with a width:height ratio of 3:1 and more exhibited post-peak strain-hardening properties. The strain-hardening properties of concrete with width:height ratios of ≥ 3:1

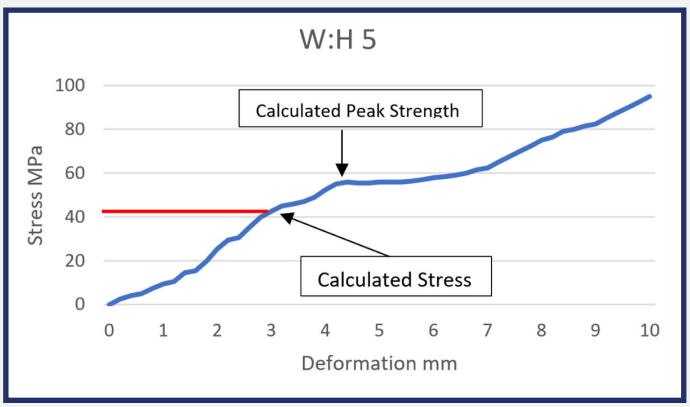
are not yet well understood, as the press used to test these samples had limited loading capabilities and was incapable of destructing the samples after 2 000 kN of load. For this reason, the mathematical equation that was used to determine the strength of the concrete pillars underground only takes into account the sample peak strength, e.g. the point on the graph where strain-softening properties are first observed. Therefore, for a 5:1 width:height ratio sample, approximately 100 MPa was used as the sample peak strength. The formula also downgraded the strength of the pack with increasing size as with the Hedley and Grant pillar strength size effect theory.



Stress deformation curves for 20MPa concrete

The concrete pillars were designed to a minimum width:height ratio of 5:1 and an industry-accepted factor of safety of 1,6 using the formula derived from the scale model tests. It was decided to use concrete pillars with a width:height ratio of 5:1 for the post-peak strain-hardening properties of the pack. The method is being employed on Modder East for the first time in the industry, so it was necessary to adopt a conservative approach. The pillar-mining project was first implemented on only 1,2 m stoping widths and only selected pillars were mined. After the favourable conditions where the pillars were mined in the first phase, the project was rolled out to more areas on the mine and included a stoping width ranging from 0,9 to 3,0 m. Closure monitoring was done during the pillar-mining phase to determine the reaction of the hanging wall when the stress is transferred from the hard-rock pillar to the concrete pillars. There was some stress fracturing on the concrete pillars, indicating that the stress from the hard-rock pillars was transferred to the concrete pillars rather than the hanging-wall bridging and remaining in suspension. It was also observed that the hard-rock pillars next to the pillar that had been mined out showed stress fracturing and fails. This effect was only observed on the hard-rock pillars right next to the pillar being mined; the hard-rock pillars further away showed no visual change in condition when the pillars were mined. It is believed that when the hard-rock pillar next to the pillar that was mined fails, enough hanging-wall movement is generated for the concrete pillar to offer the required support resistance to replace the function of the pillar that was mined.

As the pillar mining progressed, it was found that there is a certain rate of closure per day when the pillars are mined in the direct vicinity of the closure station and a rate of closure as the pillar-mining activity moves further away. Most of the closure takes place within three days when the pillars in the vicinity are mined with a closure rate of up to 0,35 mm per day; this decreases gradually to an average rate of 0,16 mm per day over a month or two (depending on the rate of mining) until the mining is no longer near the closure station and the rate of closure drops to less than 0,1 mm per day. Closure stations where there is no active pillar mining in their vicinity and all the pillars have been mined out record 0,0056 mm per day over a year. The greatest closure recorded on a closure station was 43 mm.



The virgin stress at Modder East is 8,6 MPa. The average hard-rock pillar stress was calculated using the Hedley and Grant tributary area theory. The calculated average pillar stress is approximately 68 MPa. The Hedley and Grant tributary area theory was also used to calculate the average stress on the concrete pillars when all the hard-rock pillars had been mined out. The calculated stress per concrete pack was approximately 41 MPa. The factor of safety was calculated to an industry standard of 1,6 using the peak strength of the concrete pillar. The correlation between the condition of the underground concrete pillars, where pillars were mined extensively, and the condition of the concrete samples subjected to the same amount of stress was almost identical.

After a report presented by Schalk Prinsloo

EDITORS CORNER

Rock Talk is your newsletter and we would like to hear from you.

If you have any information or stories that we can use, please submit them via email to : **info@sanire.co.za**

Your feedback will be highly appreciated.

ROCK talk

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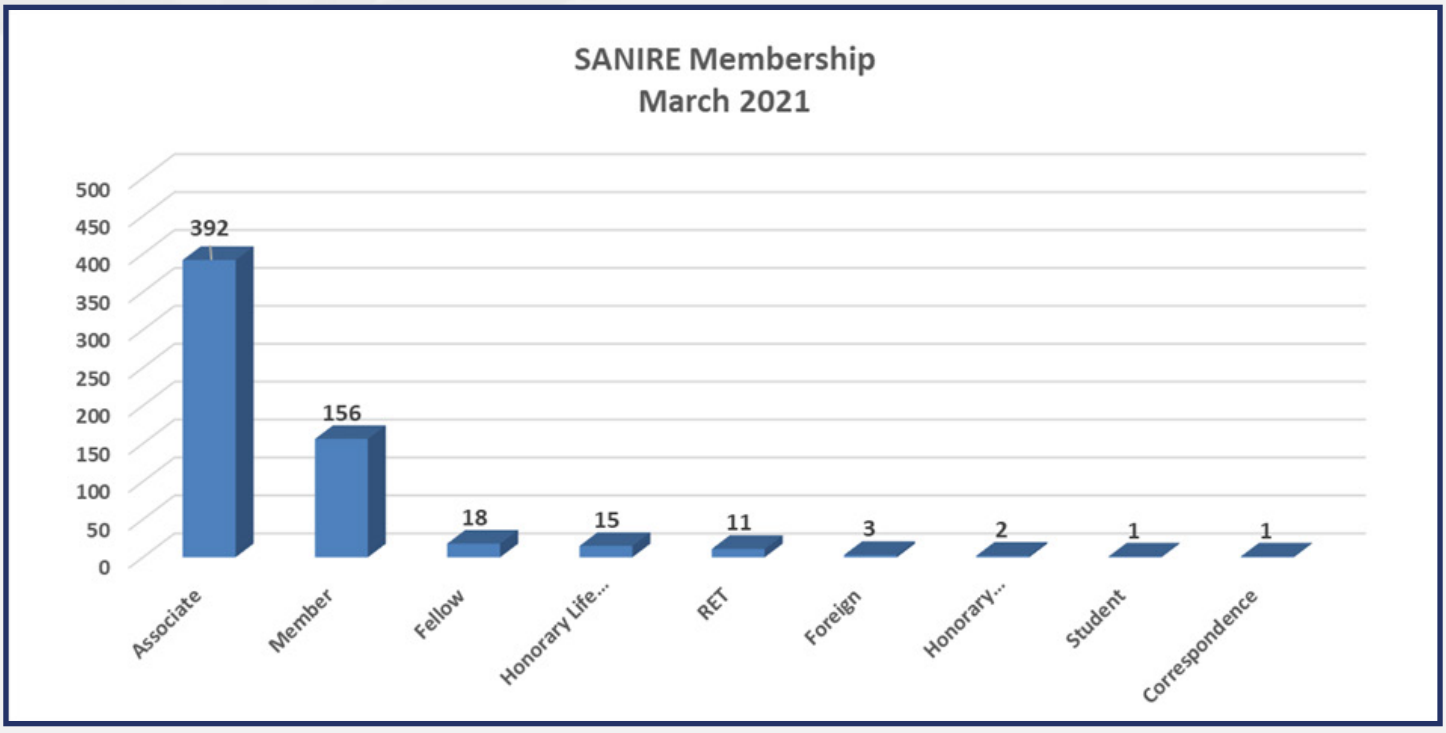

SANIRE VISION, MISSION, & VALUES

Vision

To actively promote the South African rock engineering profession.

Values

- Honesty
- Integrity
- Professionalism
- Accountability
- Transparency

Mission

SANIRE promotes the advancement of the rock engineering discipline by encouraging and promoting:

- Interest and the development of education in rock engineering
- Professional practice and high ethical standards
- Networking, collaboration and information exchange
- Research areas

CONGRATULATIONS

Following the examinations concluded at the end of 2020. SANIRE has the privilege of introducing three rock engineering practitioners who have obtained their full tickets. Thirteen other candidates obtained their strata control officer tickets.

It takes a lot of hard work, dedication and many, many hours of preparation and studies to master rock engineering. Obtaining a rock engineering ticket is hence not something that just happens. SANIRE would also like to thank the organisers, examiners, moderators and mines who made the examinations possible.

Strata control practical examination results

Region	No. passed
Western Bushveld North – metalliferous	2
Western Bushveld North – open pit	1
Western Bushveld South – metalliferous	4
Eastern Bushveld – metalliferous	2
Northern Cape	–
Freevaal	1
Coal	3

New rock engineering tickets

Surname	Name	Company	Commodity
De Wee	Gerard	Sibanye Stillwater	Metalliferous
Dzimba	Carol	South 32	Coal
Maqina	Unathi	New Concept Mining	Massive mining

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SOUTH AFRICAN NATIONAL INSTITUTE OF ROCK ENGINEERING

FOR MORE INFORMATION, CONTACT SANIRE

Mbalenhle Buthelezi
Association Secretary

Tel: (+27) 11 568 2050 | (+27) 11 568 2054

Email: mbalenhleb@mpas.org.za | info@sanire.co.za

Website: www.sanire.co.za

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