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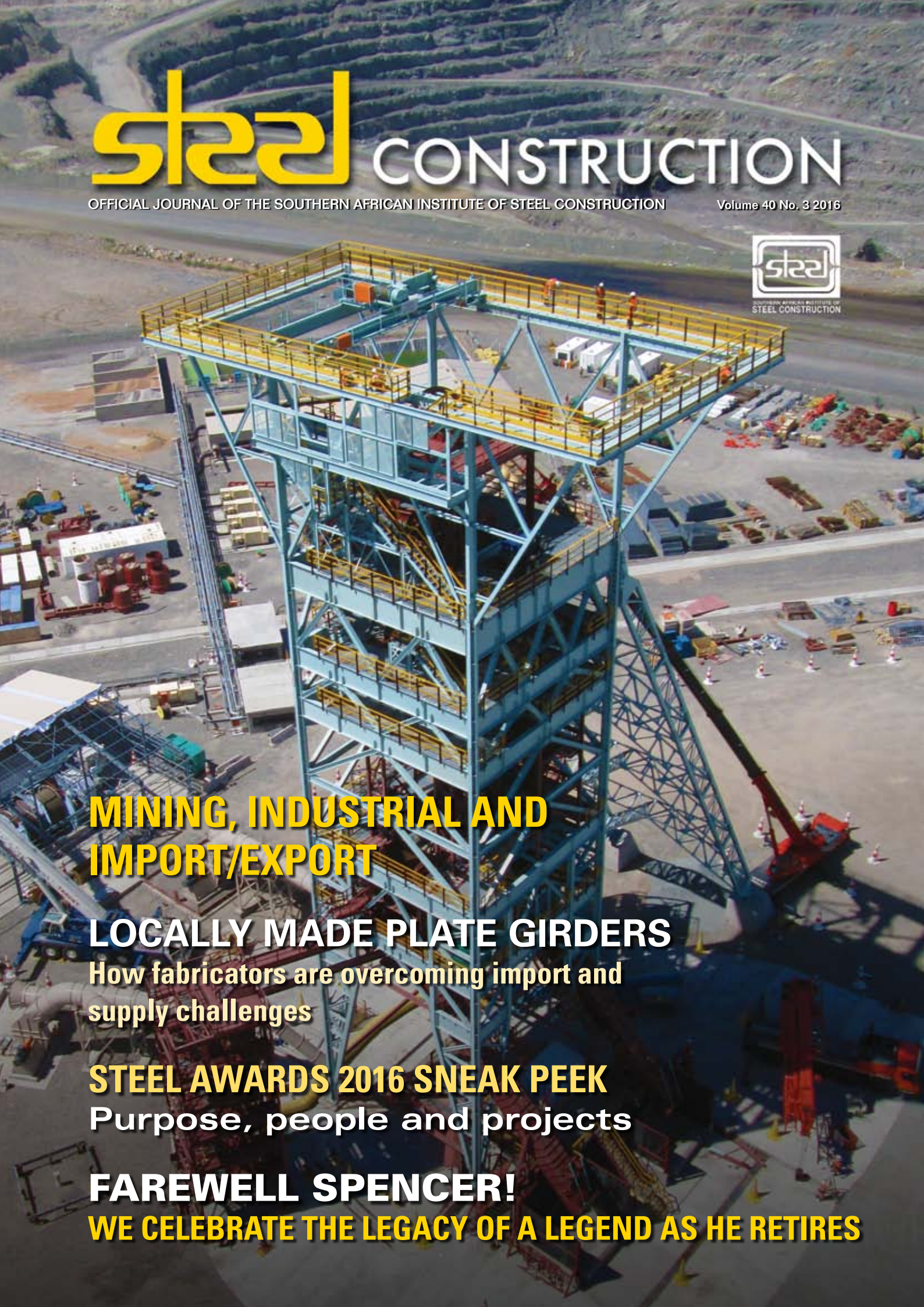

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Volume 40 No. 3 2016

OFFICIAL JOURNAL OF THE SOUTHERN AFRICAN INSTITUTE OF STEEL CONSTRUCTION

in **this** issue...

Join us on and YouTube

editor's note

"Ok. It's confession time. My love affair with Steel is still very much in the honeymoon stage, but I have a sneaking suspicion that I may be hooked for life.

Being new to the industry has meant I've had to learn a lot, fast. I'm grateful to be surrounded by industry stalwarts that patiently answer what I sometimes fear are stupid questions. Then I remember that success is a team sport. None of us is as clever as all of us (although I'm pretty sure that in Spencer's case the group "clever" is quite heavily leaning almost exclusively in his direction).

Approaching the end of my fourth month at the SAISC, and wrapping up my second (pat on the back) issue of Steel Construction, I've been reflecting a whirlwind of visits, meetings and events.

In compiling this issue, I visited Steel Services for a feature on their new beam welding line, got a sneak peek into the Steel Awards judging process, played photographer on the well maintained greens of the Bryanston Country Club and attend the Basics of Steel Course. I hope you enjoy reading this edition of Steel Construction as much as I've enjoyed putting it together.

Lastly, and very sadly, with this issue we say goodbye to Spencer – who is about to embark on the leisurely lifestyle that comes with retirement. The team behind Steel Construction will certainly miss you! We wish you all the best, and hope to still see some of your uniquely "Spencer" articles in the Journal (hint, hint).

Engineers, mills, merchants and fabricators: we need to find a way forward, together

By Paolo Trinchero, Chief Executive Officer, SAISC

Every day we read articles about the steel industry. Most not flattering at all. In a time of crisis everyone wants to blame someone else for their woes. Government, China, Policy and yes I agree, all these things have a role to play in the mess we are in. But we need to move on and find a way forward. Each and every one of us is going to have to find the strength to keep going and unlock opportunities.

The entire supply chain from consulting engineers to steel mills, merchants and fabricators find that there is not sufficient growth to generate work.

Our work load has dropped through the floor! This is borne out by manufacturing and construction index numbers and the recent release of employment figures. This is clearly not a desirable situation in which our industry finds itself. We need policy change which leads to economic growth which in turn leads to construction projects and employment growth.

If we expect the economy to continue to remain sluggish, if we accept that volatility is the order of the day, if we expect China to continue to produce and only cut capacity very, very slowly... we better find another approach to staying in business and fast.

In an article by Rian de Lange recently, "Who holds the kryptonite of South Africa's steel industry? Or is the industry of steel suffering from its own metal fatigue – self-inflicted or otherwise?" I would argue that it is the entire supply chain that has a role to play in its future. We better start working together.

If we work tirelessly on innovation and exports we may find that our competitiveness gives us a steady stream of work. This is key and recognized by many of the participants around the table. It's time to find a new box or reinvent the old one. If we have to rely on exports to see us through we better make sure we have the right skills in the industry. This is why it's so important to ensure that we continue to train even when the budget is under pressure.

Spencer Erling is retiring at the end of May. I am sure that many of you would like to wish him well and we will be holding a special cocktail function in June. Spencer has played a key role in the industry and the SAISC. I would like to thank him for his support and guidance during these challenging times. Spencer is most definitely a MAN of STEEL who we can all look up to.

"If we WORK TIRELESSLY on innovation and exports we may find that our competitiveness gives us a steady stream of work. This is key and RECOGNIZED by many of the participants around the table. It's time to find a new box or reinvent the old one."

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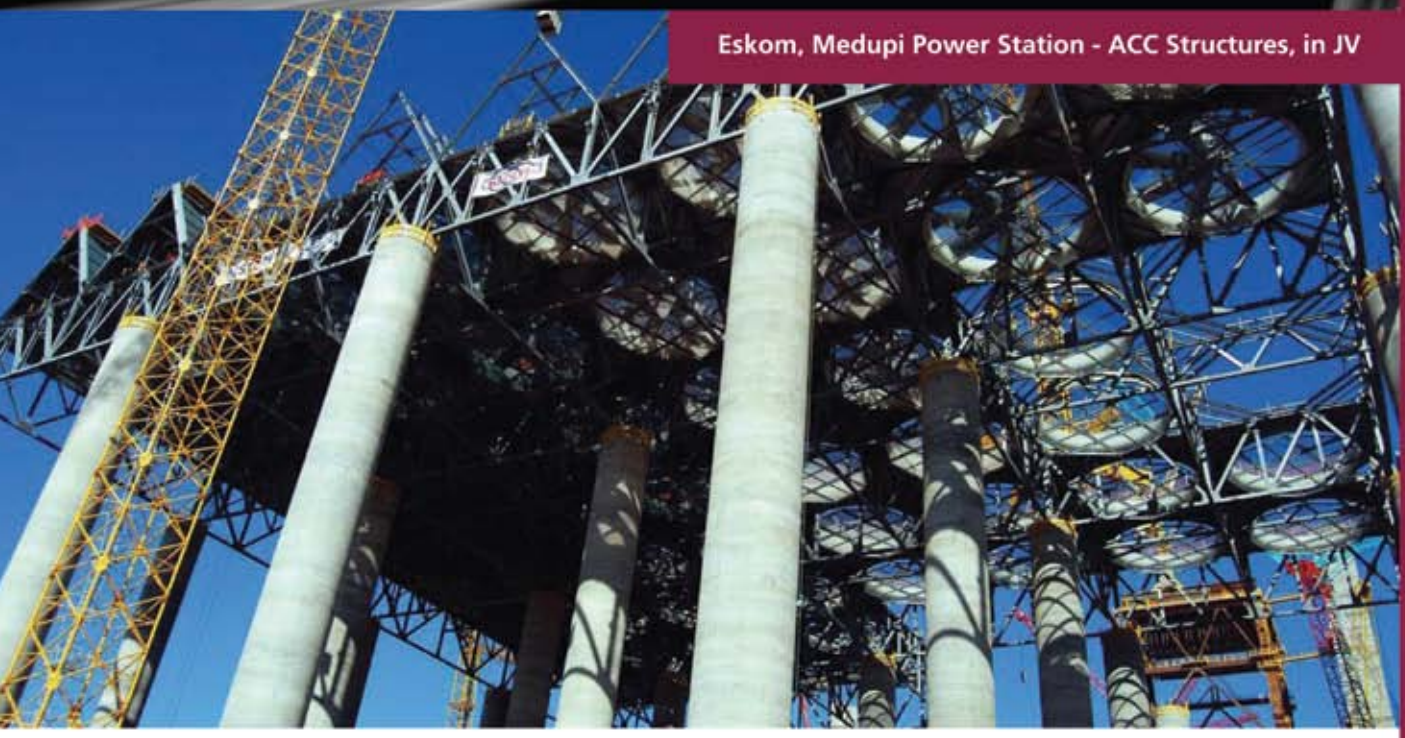

Eskom, Medupi Power Station - ACC Structures, in JV

Established in 1987, Cadcon, as a vibrant and reputable entity, has grown into a leading steel construction, designing and engineering organization involved in major projects in and around Southern Africa and internationally. Cadcon operates from their 15 400 m² workshop and office facilities in Centurion, Pretoria, housing state of the art machinery and latest technology CNC plate, beam, angle, cutting, drill and saw facilities serviced by 20 overhead cranes. Cadcon has also implemented the FabTrol System providing drawing management, material nesting, purchasing, inventory control, production and CNC management, shipping and more.

Eskom, Medupi Ducting Supports, Lephalale

Planning and completion of various significant and complex national and international projects on time, for commercial, industrial, mining and plant sectors, serves as testimony putting Cadcon as a leader at the cutting edge, in a rapidly growing and competitive environment. Cadcon has valuable experience in exports of steel products internationally and strong innovative contributions to the whole of Southern Africa.

Overall Winner SAISC Steel Awards 2011
Sandton City - Protea Court Rooflight, in JV

Furthermore, Cadcon's unique packages include the design and supply of buildings through Mictec, Cadcon's in-house engineering design department. Additional services include crane, truck and trailer hire.

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DEALING WITH SUPPLY CHALLENGES FACED BY FABRICATORS

by Kevin Harris, Director, Steel Services

"Necessity is the mother of invention and when times are tough it forces us to be dynamic and innovative.

The beam welding line is a key part of how we see our business developing."

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Every fabricator in South Africa is facing challenges in current market conditions. There is a lot of uncertainty around which sections will be available, which will be imported and which will be manufactured locally. It would be really useful to have a reliable supply of steel at a stable price, but I'm not sure that that's possible.

2016 has so far proven to be a very challenging year, with inflationary prices on steel because of issues with supply. This puts tremendous pressure on fabricators like us.

The structures that we produce contain a lot of heavy sections, the sections that Evraz Highveld would typically supply. We've had several occasions where material we were looking for wasn't available. Many of the merchants have begun importing these sections – but the lead times are long, and the prices are not really confirmed until the material has landed. The upside of the challenges is that they force us to be a little more dynamic about the way we run our business. We've found a way to produce standard mill sections or equivalents/ replacements by welding them up on our new beam welding line.

Necessity is the mother of invention and when times are tough it forces us to be dynamic and to do something differently. The beam welding line is a key part of how we see our business developing. We've used it internally already to produce 30 tonnes of universal

column (254 x 254 x 132), for use in the Mopani Headgear Project that we've entered for the 2016 Steel Awards *(See Pg 18 for Project).* These were sections that we would have bought from the mill.

As far as costs are concerned we estimate that a fabricated beam would cost 20 to 40% more than a mill produced beam, depending on the foot weight of that particular beam. The driver of cost on a beam welding line is linear meters, not tonnes. The lighter the beam is, the higher the labour component of the fabricating of that beam becomes. The heavier the beam is, the smaller the labour component is as a percentage of the overall cost. So it really depends on the particular beam we are producing.

There are other drivers of cost, whether full penetration weld is required or whether a standard fillet weld is specified, and what kind of testing is required. The beauty is that we can perfectly tailor the beam that we produce to the application, and that in itself is an efficient process. We have less scrap. The beam is no heavier than it needs to be – and there are savings in there. Although the direct cost is 20 to 40%, that extra cost can sometimes be offset by the savings, or the gains in efficiency.

TOP LEFT: 2 of the 4 welding heads together with run on plate.

TOP RIGHT: Box beam – 1 200 x 700 (40W, 60F) 1 338kg/m.

BOTTOM LEFT: Run on/run off plates preheating flame.

BOTTOM RIGHT: Groove preparation for complete joint penetration weld (full pen butt weld) for the box beam.

Despite the fact that it's more expensive to produce sections that way, we're able to deliver the project without time delays. That adds more value to the project than a small cost overrun on that particular section.

Currently a significant portion of the machine's capacity is dedicated to internal work, but we certainly are open for business as far as this machine is concerned. We're willing to produce plate girders for anyone – whether it be a merchant or another fabricator.

The machine has four separate welding heads, so we can do a double deposit weld, both sides of the web in a single pass, in approximately 3 minutes per running meter on the beam. If you consider the welding is happening on both sides of the web, that's 2 meters of welding in 3 minutes – which is far faster than can possibly be welded by hand. I know that Spencer uses a rule of thumb of approximately 4 meters per hour for a hand weld. That would probably be a 6mm fillet hand weld. Typically we would put down a 10 – 12mm fillet weld with no prep. If the client requires, we can do full penetration welds on up to a 50mm web, and 60mm flange. So the speeds and efficiencies are far better, and the quality of the weld is much better too. It's a submerged arc welding process. Constant speed, constant feed – and the quality of the weld is far better and faster than any hand welder could achieve on a weld of that type.

There are several opportunities that arise when fabricating sections. The first opportunity is that you can fabricate the section in any length you like. If we need a 5m long beam of a certain size, then we produce it. We don't have to over design, simply because that's all that's available. That means that there is no wastage, and it means we can be very specific about what we are fabricating. We can optimise the mass of the beam by adjusting the thicknesses of the flanges or the web.

When one buys a mill standard, you have only a few choices of that size as far as mass is concerned. So we can really tailor the mass of the beam that we are producing to the application and in so doing we can also control the cost. We will also experiment with tapered beams, beams that have a changing profile, which presents opportunities as far as pre-engineered buildings are concerned. We're very interested in that kind of approach.

Steel Services is committed to South African business and we would really like to see these beams and sections supplied from inside South Africa.

To see the new Steel Services Beam welding line in action visit the SAISC's Youtube page: *http://ow.ly/ZLIY300mG1p*

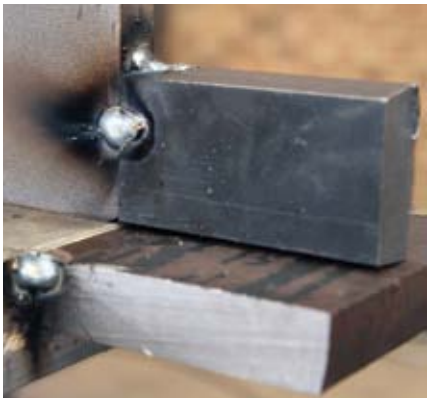
TOP LEFT TO RIGHT: Run on/off plate detail.

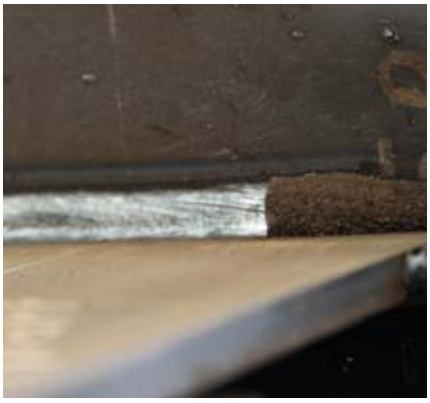
BOTTOM LEFT: Control centre.

BOTTOM CENTRE: Vacuum recovering unused flux.

BOTTOM RIGHT: The great quality welds.





Aki Luntamo,
BIM Master, Sweco, Tekla
BIM Awards 2015 winner

In the hands of the BIM master, architect's drawings evolve into constructible 3D models that develop into real buildings. Tekla software is at the heart of the design and construction workflow, building on the free flow of information, constructible models and collaboration. We have changed our company name to Trimble.

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CHINESE BORON STEEL: A FEW WORDS OF warning FOR OUR FABRICATORS

By Spencer Erling, Education Director, SAISC

The hardness of the heat affected zone goes up with steel with Boron in, even at fairly low percentages (1 to 4 parts per million or .0004%)

Background

It is relatively common knowledge that Chinese steel mills added some Boron to their chemical composition of export steels.

The reasoning behind this was the export tax that China imposed on Carbon steel (the full name of the steel we use). But if the mill added some Boron (as low as .0008%) the steel was considered an alloy steel with a substantial reduction in the export tax or effectively an export subsidy.

Whilst some changes have been brought about to the Boron steel tax reduction, some Chinese mills are now adding (apparently with some difficulty) Chromium into the mix.

The impact on fabrication due to adding Boron to steel

It is common knowledge that the Boron hardens the steel, generally without affecting the ability of the steel to meet the requirements of specifications such as S355JR.

Does the Boron have an impact on welding?

The answer is probably yes.

Some of the information I found on Google is clear that the hardness of the heat affected zone goes up with steel with Boron in even at fairly low percentages (1 to 4 parts per million or .0004%). Boron percentages in steel exported is a minimum of .0008%.

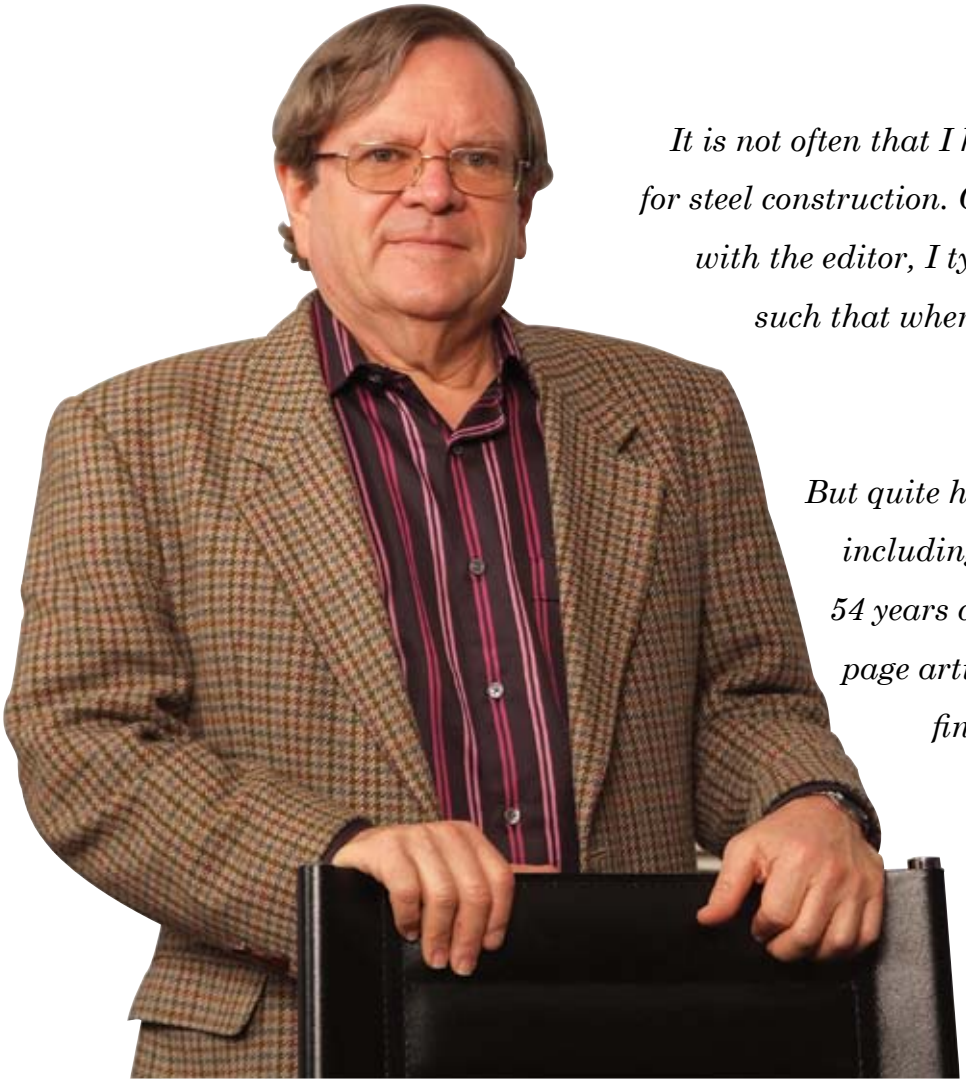
Conclusion

Talk to your friendly welding engineer. Show him material certificates of steel from China with Boron in the steel. Let him confirm that your Weld Procedure Specifications are still suitable. The speed of cooling has a big impact on this hardness, so pre-heating requirements could be affected.

PS If your steel contains chromium the question to your welding advisor is just as valid.

Ed. *A special thanks to Bruce Saxby for alerting us to this issue during his talks presented at the Basics of Steel course 2016.*

SPENCER TELLS US *about his* GREAT CAREER IN STRUCTURAL STEEL



It is not often that I have battled to write an article for steel construction. Once a subject has been agreed with the editor, I typically mulled over the article such that when I sat down with finger on key board, the article just flowed.

But quite honestly, my engineering career including education has spanned some 54 years and condensing that into a few page article has me battling, this is the final version of numerous drafts.

BELOW LEFT: Multistory Buildings in Israel from the Girder Naco days.

BELOW CENTRE: "Engineering Machines", Container Handling Cranes.

BELOW RIGHT: Lounge node in transit from Construction Yard to Main Airport Building.

Why Engineering?

My late father Bert Erling in 1948, by taking over the debts, bought Speedy Welders. And they did precisely that, welding repairs and the like. His experience before that had been in structural steel fabrication with Sydmor Engineering (Later to become Power Steel and after that Genrec). So once he had made some profit (he described his jobs as 75% profit in the early days) he bought a Peddinghaus punch and shears and was back into the structural business. My older brother Michael was the sibling who wanted to work in the business, but when he flunked out of engineering at Wits, my future was kind of pre-ordained for me.

This between 1963 and 1966 I read for and completed a B SC in Civil engineering at Wits.

I was lucky enough to get a job at Dorman Long Africa (Later Dorbyl, DSE and now Aveng Fabrication) in their design office under the doyen of the industry Tommy (Bernard) Thompson. Amongst my mentors in that office were Cameron Napier, Norman Ellis and on the other side of my drawing board was Alan Kemp who went on to become Professor of structural engineering at Wits. But after a year in that office the Defence Force caught up with me and so in 1968 I found myself doing military service.

Once again luck was with me, after basic training my engineering degree was recognized and I was transferred to the Professional Design Office which was a part of the Quartermaster General's department.

BELOW: Construction of the North end of the International Conference Centre in Durban.

Working for another great mentor, Danie Toerien I found myself working on a whole series of secret projects, which was great exposure and experience. My most "important project" (certainly from the military's point of view) was to design and supervise the building of the reinforced concrete structure for the Services Golf club house in Voortrekker Hoogte. This was my only real exposure to reinforced concrete in my career.

By this time Bert was nagging for me to join Speedy Welders but agreed that I should do an MBA before joining the company. The year 1969 was spent at UCT with a class many of whom have risen to business fame such as Stewart Cohen (co-founder Mr Price), Ian Kantor (co-founder Investec Bank), Mike Levitt (went on to be the Chairman of Old Mutual) and and and.

20 years at Speedy Welders

Having successfully completed the MBA course, on 29 September 1969 I joined Speedy Welders. I can safely say I did every job description you can think of related to the structural steel process, from sweeping the floor, design engineer, detailed drawings, machine operator, buyer, QC inspector, site manager and the like through to Managing Director. I might add that my first efforts at project management was an unmitigated disaster. We ran weeks and weeks late. Talk about induction by fire, but what a learning curve.

The projects that really stand out in my memory from those days included major steel works for the Sishen South plant, the Sishen Saldanha export project (6 000 tons of steel), President Brand uranium plant, President Steyn 4 shaft, FSG 5 shaft, diamond plants for Letseng and various de Beers mines in Namibia, coal plants and conveyors for New Denmark colliery and Tutuka Power station, numerous plants for AECI (including a replacement nitro-glycerine plant because the existing one blew up. This was in answer to a Sunday afternoon call at home, "Spencer, please get another structure going like the one you did a few years ago, we will let you know when you can erect it…").

On the commercial side we worked on many shopping malls, Westgate, too many OK Bazaars and Pick n Pay stores to mention. Sun hotels were also great customers, we worked on the Cascades at Sun City, Thabanchu Sun, River sun *and and and.*

The lasting memory about the way we did business in those days was how important the hand shake was. Relationships with your customers was all important. We regularly received calls to come and collect a set of drawings to urgently start on a project to be erected some weeks ahead, with the final word being "oh and by the way let me have a price before you finish the job". In most of those cases we would have been paid in full before (if ever) the written order was received.

In 1979 Speedy Welders became a fabricating member of the SAISC and I started to attend meetings. I soon became a committee member.

At our peak we were fabricating about 500 tonnes per month. I do not think we ever posted an order to a steel merchant. Most order numbers were "Verbal Spencer". We trusted and respected each other, which made doing business with "friends" much more fun.

One of our more exciting periods was in 1979 when we decided to invest in NC controlled drill line and templating punch machines. Once again we chose Peddinghaus equipment. Visits to factories in Germany and the USA to see this equipment on workshop floors helped us make the right decision. All our drilling information had to be keyed in to the microprocessor through a key board on the machine. We were so excited when the machine drilled holes in 20 seconds (slow compared to 3 seconds these days). Having this entry level state of the art equipment made us one of the best equipped medium size fabricators in the industry.

At about the same time we bought our first "Hewlett Packard" desk top programmable calculator (a mini-computer in today's terms). Our co-director Billy Rimmer who was an expert detailer and a good hand at designing simple structures took to the HP Basic language programming like a duck to water. Between us we developed a program for detailing floor beams. All be it one at a time it was never the less much quicker than by hand and was great to be involved in our own CAD efforts. We even managed to sell a few copies of the program, one finding its way to Australia.

Not that we did not have our bad contracts. A 1983 /4 project, which shall remain nameless, ended up in a claim situation amounting to R1.5 million, an enormous amount of money in those days. Our client repudiated the claim and forced us to go the arbitration route. Our clients were masters at delaying tactics and managed to delay the arbitration for well over 2 years, and literally on the steps going to the arbitration they made us an offer to settle. Bert who had long before lost the appetite to continue the fight agreed to settle for way below what

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we would have been paid by the arbitrator, leaving us always short of cash in the business.

In 1989 my brother who had since joined us decided to emigrate to the USA, Bert was now 75 and wanted out, I realised that I no longer desired to run the business with only "2 family eyes" and decided to sell out.

Girder Naco bought a substantial part of the business and I went with.

12 years at Girder Naco

At Girder Naco I ran the construction division, the estimating department and was responsible for all technical issues. The nature of their projects was much larger, heavier and with it new challenges.

In January 1990 Louis Breckenridge took me to Israel and we came back with an order for a 14 storey building, the first of many building orders. I can safely say that Girder Naco was responsible for changing many parts of the Tel Aviv skyline.

We had a 9 year run where in some years we exported 6 000 tons of steel to Israel. But it had to happen sooner or later, local steelwork fabricators realised that to beat us at our game they needed to invest in NC controlled fabricating equipment, 3D detailing packages and deal with those 3 very important erection issues, verticality, more verticality and more verticality. We finished our last Israeli project in 1999.

I became responsible for most of that export work. Amazingly all but one of our 29 export projects during my time were profitable.

My nearly 12 years at Girder Naco was a new lease on life for me, the challenges associated with contractual issues and the technology of detailing, fabricating, welding, quality control, shipping and erection of those heavy components set me up to deal with my position at the SAISC.













Some of our standout projects of those years included those multi-storey steel framed buildings the tallest of which was 29 storeys, the heavy engineering machines such as stacker-reclaimers, ship to shore container handling cranes, work on the aluminium smelter projects, work on the Richards Bay Minerals project, the cold rolling building at Columbus stainless steel which was about ½ a kilometre long. The most complicated by way of geometry bc (before computerized 3D packages could deal with that complexity) was the North end of the International Convention Centre in Durban.

My favourite project of all the years I was in construction was the 3 triangular nodes that we added to international departures at the then Johannesburg International Airport (now OR Tambo). These 200 tonne structures were assembled about 1 kilometre away from the current positions and towed onto site starting at 10.00pm.

A close second comes the work we did erecting the Saldanha steel continuous casting project where at times we had over 300 people on site.

Yes they were exciting times that I look back on with pride. It gives me a great kick to see some of our projects years after their completion, whether for the first time or one of many visits. Right around the corner from us in Jan Smuts Avenue is a bridge that Speedy erected one Good Friday morning.

In 2001 I came to the conclusion that life had to be worth more than 7 days and 5 nights a week working for a contractor. I left Girder Naco and joined a smaller contractor for a relatively short time, but it did not work for them or me. At about this time (September 2001) I attended a breakfast gathering and found myself sitting next to and chatting to a lady I had not previously (nor subsequently) met. After a while she asked me for my business card and as soon as she realised I was a Professional Engineer (registered in

SOME FAREWELL MESSAGES *from our* STEEL CONSTRUCTION JOURNAL READERS

Spencer has had a such a tremendous personal and professional impact on so many people. Here is a small selection of some of the messages sent in by Steel Construction Journal readers. Rest assured that all messages sent in will be passed on to Spencer, but for the sake of space, not all have been published here.

"Spencer, since we first met as fellow GDE students in late 1970's you have been the first person that I have phoned to discuss or ask your advice relating to construct-ability of steel buildings. Your practical experience from the Speedy Welder days and your work with SAISC has given you deep insight and knowledge which you have always been happy to share with others – a rare attribute!! Your contribution to the engineering profession in South Africa through informative notes and lectures as well as at SAICE functions is legendary. Hopefully you will continue to take an interest in your passion for many years to come." **– Don Midgely, RMCE**

"It has been an absolute pleasure to work with you, your wealth of knowledge and the way that you have been willing to share it with all is to be highly commended, we wish you good health and happiness in the years ahead. You will be deeply missed." **– Tim Tasioulas, TASS Engineering**

"Thank you for your response to numerous questions over the years, for your overall contribution to the industry and in particular the SAISC initiated conferences and courses." **– Peter Gage, Jones & Wagener**

"Spencer is a double legend – both academically and practical." **– Anton van Dyk, Nako Group**

"Thank you very much for the practical advice you could give off the cuff; it is wonderful to be able to trust advice unreservedly. Your retirement is the loss of the steel industry. Hope you will keep on writing technical articles for publication in the steel magazine." **– Dawie Malan**

"Sir you were and always will be a leader (I know you will not sit back now)" **– Leon Cotzee, TWProfile**

"Without doubt Spencer's contribution to the education and training of structural steel designers will be missed. I look forward to continuing our friendship beyond steelwork!" **– Rob Young, Young & Satharia**

"Thanks for everything Spencer, you are a legend in the structural engineering industry. I have appreciated your helpfulness and in depth knowledge and understanding of the industry. There are many young engineers who indeed owe you a debt. I suspect we have not seen the last of you." **– Bruce Saxby, BSi Steel**

"Your energy, wit, support, brilliance and tireless energy will be sorely missed in and out of our Association Board meetings. Wishing you a well-deserved rest in your retirement and enjoy smelling the roses and quaffing a glass or two of wine! Best wishes." **– Dodds Pringle, ISF**

"Whether it was from behind your desk doing an article, a speaker at a course or teaching, you have done it to serve the industry and more importantly to serve the people of the industry by developing us." **– Roelf Lizemore, SAISC School of Draughting**

"Hard work, dedication and a positive attitude. Just some of the qualities you have shared with us each and every day. We are sad to see you go but you leave our industry in a better place thanks to your contribution." **– Ben Garrad, CEA**

"Whenever I needed to discuss a steel related issue Spencer would always be a great sound board and often gave an alternative view that was compelling. Thanks, dankie mille, grazie. I salute you as a man of steel!!!!" **– Franco Mordini, ASTPM**

"A great mentor and friend! I'd miss him except for the fact that I intend to keep him close." **– Amanuel Gebremeskel, SAISC**

"To have you as one's colleague is to be empowered in the knowledge that one will always have able, loyal support." **– Hennie de Clerq, former SAISC CEO**

"Thank you for sharing your knowledge and enthusiasm for steel. The SAISC, its sub-associations and members are grateful for all the support they have received from you. We wish you a happy retirement and hope that you will stay close to us." **– Paolo Trinchero, SAISC CEO**

1976) she asked, as a professional engineer what did I do for a contractor? Without any thought out popped the reply,"I am a professional fire fighter, shit swallower and contract lawyer wrapped up into one".

That night over dinner I told Hazel about my new job description. At 2 o'clock the following morning I woke up worrying about this remark and decided if that really was what my job meant, it was time for a change.

At 7.00am the following morning I phoned Hennie de Clercq, who I knew very well, and asked if he was still looking for an education director... and the rest is history.

Spencer and the SAISC

As I said earlier I became involved in the SAISC in 1979 during Hennie's first stint. After a while I became involved in committee work for the SAISC including the draughting of various specifications.

Amongst the early documents was SABS1200H and its addendums, which was the document that told us what to do to get a good steel structure. The chairman of that committee was Don Walker.

I was also involved with the new categories of site erectors payment scales (developing the concept of slinger and catcher amongst others).

During the 1990's I was Chairman of the board for 2 years and also Chairman of the finance committee, which role I did for longer than I care to remember.

So in 2000 when Kurt Horngren left, between the then Chairman, Kobus de Beer and myself as Chairman of the finance committee, we were appointed part of the team to find a new Executive Director.

Hennie de Clercq applied for the job and was duly appointed.

After Roy Mackenzie, John Duncan and Paolo Trinchero left the SAISC, Hennie was looking for replacements. Gary Drummond of EDM was appointed to find suitable candidates. Gary kept calling me to know if I had suggestions, or didn't I want the job... I guess his persistence paid off and here I am.

Working for the SAISC was another complete new lease on life. Hennie's management style left me to my own resources as long as we satisfied the board's requirements.

It has been so different from contracting, but it was great to bring those contracting skills with me and develop ways and means of passing them on to the rest of the industry.

It has been so rewarding developing the various courses that I did for both industry and university. It is very satisfying to know that I, together with Hennie earlier, then Kobus and Paolo of late have and really do make a difference for our industry.

There are so many perks to this job:

Meeting great lecturers in structural steel subjects including Professors and spending time with them.

Meeting our international colleagues as well as fabricators from all around the world.

Attending great conferences and exhibitions.

Being paid to read and keep up with technology developments.

The opportunity that steel awards judging presents to visit all those fabulous steel jobs, coming away knowing you have been exposed to something very special.

What are some of the highlights of my sojourn at the Institute?

- Steel awards which I convened for 14 years, and watching it grow in stature and status. Writing the script for the voice over for the videos, managing camera men, being involved in the video production and writing numerous articles.
- Working with sister institutes both locally and internationally including the SAIW and HDGASA.
- Playing the role of Financial Director, Company Secretary.
- Being able to answer and advise on many hundreds of technical and commercial queries,
- Developing the costing and estimating course, the workshop supervisor's course, the assembler's course, basics of steel course, development of the SAISC site safety program and associated courses for fabricators and engineers, QA courses for engineers amongst others.
- Developing with Hennie a new retail steel price index E Ex for SEIFSA
- Running courses at university, seeing the spark of recognition on the student's faces, being appreciated by way of good scores in the tests I set, including only one person who achieved 100%.
- Lecturing practising engineers on new technological and safety issues.
- Code and specification writing.
- Part editing of Steel Construction and writing of articles.
- Becoming a bit of a specialist on the new 898 and 14399 bolt specifications for pre-loaded bolt assemblies and dealing with numerous issues, queries and writing articles on the subject.
- Dealing with hundreds of technical and contractual queries that crossed my desk over the years.

Perhaps the most challenging project that certainly took the longest to sort out was a decision taken by the SAISC board at a meeting when I was not present which simply stated said "Train steel detailing draughtsmen".

Little did I realise that to do it correctly meant dealing with CETA (Construction Seta) a process that took years for us to get the DSE/ SAISC school of draughting registered, get the qualification registered on the SAQA list which meant geting objections (by ECSA) removed, get a syllabus written in the detail CETA wanted it (at a cost of R2,000,000.00 half of which was funded by CETA) and and and.

I realised that all my training as an engineer in construction who was paid to make things happen was to no avail when dealing with organisation like CETA.

My favourite expression ie why do you bang your head against the wall?... because it is a lovely feeling when you stop, applied totally in this case. Thank goodness, never again!

The SAISC school draughting as it now known, is I am proud to say producing excellent graduates many of whom have already made their mark in the industry all be it at a great financial cost to the SAISC.

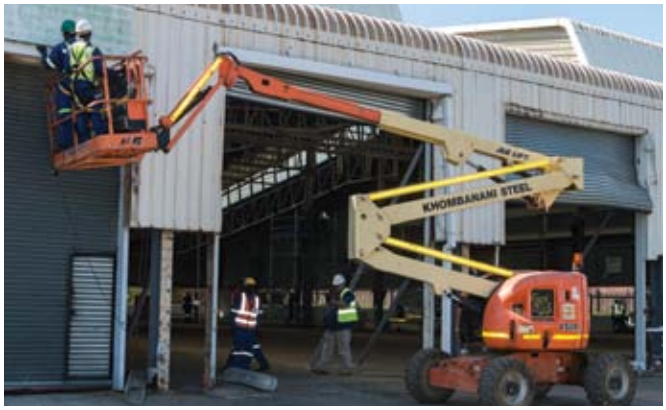
A final word

My philosophy in dealing with customers and suppliers has been to build a relationship based totally on honesty and openness and I truly believe it worked.

Thanks to all of you our readers, members and supporters, I am truly grateful to each and every one for the respect and friendly manner I have been treated to during my stay at the Institute. I am truly grateful for having had the opportunity to put something back into this great industry which has provided me with so much fun, so many challenges and such job satisfaction.

This is definitely not a final good bye, I believe that I will be helping the Institute with running of some of the courses in the future.

MINING, INDUSTRIAL and IMPORT/EXPORT PROJECTS



Aeroton Roof Jack Project

"This Project is an excellent example of how an existing industrial warehouse type structure can be rejuvenated and given a new lease on life in an economical and time effective way."

The client, Fortress Income Fund, approached L&S Consulting and Quanticost Pretoria in October 2015 to investigate the options to raise the roof of an existing 3 800 square meter warehouse by 4m in order to provide the necessary storage volume for a prospective tenant.

The consultants approached Tass Engineering to provide a price to dismantle the existing roof structure, extend the columns and re-erect the existing structure or to demolish and construct a new structure. Tass Engineering in turn proposed to jack the entire roof in a single lift operation to the required height, with the structure remaining intact including roof sheeting and side cladding. This option was priced with taking the time constraints of the project into consideration and was found to be the most viable solution.

The existing warehouse structure comprises of steel trusses, spaced at 6m centres and spanning 31m, supported in the centre by a lattice girder spanning 24m between columns. The trusses are supported by full height steel columns along the perimeter. The structure is clad with IBR sheeting on the roof and the sides, with monitor frames provided on the roof and clad with translucent sheets.

For this application, steelwork is the ideal material of choice, due to its strength and availability of various section sizes to suit an existing structure's section sizes. This project is an excellent example of how an existing industrial warehouse type structure can be rejuvenated and given a new lease on life in an economical and time effective way.

The existing structure relied on portal framed action to resist the wind loading on the structure. The additional stresses due to the increased wind loading as a result of lifting the roof, exceeded the resistance capacity of the portal action of the structural frame. Also, due to the time constraints, no strengthening of the existing foundations could be considered to resist the increased forces.

A bracing system was designed and installed to resist the increased in-plane forces without having to alter the existing foundations or to strengthen the existing perimeter columns. The increased height of the structure had a negligible additional gravitational loading on the existing foundations.

The innovative lifting operation proved to be a safe, cost effective and time saving solution to alter an existing facility to be suitable for a prospective tenant. Going forward this option should be considered as a viable option to provide increased storage capacity to existing facilities.

PROJECT TEAM

Client: Fortress Income Fund

Architect: O-Inc

Structural Engineer: L&S Consulting

Quantity Surveyor: Quanticost Pretoria

Main Contractor: Abbeydale

Steelwork Contractor and Detailer: TASS Engineering P/L

Cladding Supplier: Tate & Nicholson

Steelwork Erector and System Implementation: IHJ Engineering

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- Gautrain O.R. Tambo Platform Extension (100t) - Gauteng Provincial Government
- Rosebank Towers (130t) - Abland
- Natalspruit Hospital: Bridge and Doctors & Nurses Accommodation (250t) - Department of Infrastructure and Development
- Government Printing Works (300t)
- Discovery Sandton (220t) - Zenprop
- Integrated Rapid Public Transport Network (200t) - Ekurhuleni Metropolitan Council
- Golden Era Can Line Plant (525t) - Golden Era Group
- EPX Warehouse (225t) - EPX
- Northgate PV Support Structure/Car Ports (100t) - Sasol Pension Fund
- Aeroton Roof Jack (3 800m²) - Capital Property Fund
- Fourways Mall Roof Structure (60t) - Fourways Precinct
- Discovery Corporate Offices Sandton, Skylight Roof (50t) - Growthpoint Properties
- Lusaka Health Centre - Shimizu Corporation

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Mopani Headgear

"Connection in the headgear structure was designed to facilitate ease of shop fabrication and site erection. Close co-ordination was required between Hatch and the fabricator, Steel & Allied Services, in order to ensure that the strict quality control requirements were met."

Mopani Copper Mines approved the sinking of the new Synclinorium Shaft at the Nkana Mine site in Kitwe, Zambia, in 2010. The reason for the shaft was to access the Synclinorium ore body and Mopani needed to modernise the hoisting, improve the efficiency of mining operations, and required a hoisting capacity at Synclinorium of 4.0 Mtpy. In order to achieve this objective a 7.0m diameter shaft was sunk using conventional methods utilising a headgear and winders supplied by the Sinking Contractor. The permanent headgear was erected after the sinking and lining of the shaft was complete. The total project cost was USD 323 million.

The permanent headgear is a 64.625m tall structure measured from collar to top of crane structure with a total mass of 1 300 tonnes. This includes the mass of the headgear structure, bin, flooring, hand railing, and stair treads but excludes all mechanical items.

The headgear was designed to accommodate two skips, each with a payload of 26.5 tonnes, and a total hoisted mass of 47.5 tonnes per conveyance. A Blair Winder was selected to achieve the design hoisting requirement of 4 million tonnes per annum.

A steel headgear consisting of fabricated box girder vertical columns was positioned on the centre line of the shaft together with fabricated box girder raking legs. The main framing beams were also constructed utilising fabricated box girders. The bin structure was designed to be integral with the headgear for stability particularly under emergency loading i.e. hoisting rope break condition. This structure was also clad with Chromadek coated IBR sheeting in an attempt to reduce dust and noise pollution due to the close proximity of the shaft to the local community. Connection in the headgear structure was designed to facilitate ease of shop fabrication and site erection. Close co-ordination was required between Hatch and the fabricator in order to ensure that the strict quality control requirements were met. Hatch conducted regular shop fabrication inspections to ensure that the strict quality control requirements of the project were met. Trial assembly of the components at the fabricators premises vastly minimised the risk of lack of fit to various assemblies on site.

The fabricated box girder design enabled the Sinking Contractor to pre-assemble each floor complete with hand railing, and included flooring (where permitted by mobile crane lifting and reach constraints). Each floor module was erected in sequence using purpose made lifting brackets and attachments, designed by Hatch to facilitate the erection. The headgear was erected and commissioned in 55 days, of which 14 days were spent on installing the compensating sheaves.

PROJECT TEAM

Client: Mopani Copper Mine

Structural Engineer: Hatch Goba

Quantity Surveyor: Mopani Copper Mine

Project Manager: Hatch Goba and Mopani Copper Mine

Main Contractor: Murray and Roberts Cementation

Steelwork Contractor: Steel Services & Allied Industries

Structural Steel Detailer/Detailing Company: Cadhouse Design Enterprises

Cladding Supplier: Steel Services & Allied Industries

Main Steel Erector: Murray and Roberts Cementation

Steel Erection Supervisor: Steel Services & Allied Industries

Saldanha LPG Bullets

"The Bullet poses unique problems with handling during the fabrication process, transportation and erection due to its weight and size. Every lift carried out is a "heavy lift" and careful planning and adherence to safe practice were crucial."

This project included the mechanical design, fabrication, site installation and testing of 5 number LPG storage pressure vessels (Bullets) manufactured to AMSE VIII Div 2 and EEMUA 190. Each Bullet is 7,000mm in diameter x 68,000mm long x 40mm thick plate, weighing approximately 580 tonnes. The Bullets were manufactured in A 516 grade 70 LT 40 carbon steel plate for its strength and suitability for low temperature service. These are some of the largest Bullets to be manufactured (worldwide) and presents unique challenges throughout the manufacturing process. This is the heaviest LPG vessels fabricated in one piece in South Africa.

The Bullets were designed to ASME Div 2 and EEMUA 190 and a finite analysis was carried out to ensure the Bullets met the requirement for transportation to site and ultimately the operating conditions

As will be appreciated the Bullet poses unique problems with handling during the fabrication process, transportation and erection due to its weight and size. Every lift carried out is a "heavy lift" and careful planning and adherence to safe practice were crucial. All welds were 100% NDE tested. Handling, rotation of shell sections during welding and assembly of the shell sections all posed challenges and constant care was need to ensure the assemblies were located correctly on the rotating equipment during these operations.

Post Weld Heat Treating (PWHT) the whole Bullet after manufacture. This was done by using LPG heaters to heat the Bullet internally with insulation on the outside. No one has built a Bullet this size in South Africa, we made 5 of them, to specification, the correct quality requirements and on time.

A key element of this project is that Efficient Engineering sourced and trained local (Saldanha based) labour, contributing to developing skills within South Africa.

PROJECT TEAM

Client: Sunrise Energy

Project Manager: Efficient Engineering

Main Contractor: Efficient Engineering

Venetia Underground

"The headgears were designed to be assembled in modules that could be pre-erected and then lifted into place, thereby reducing the need for the 100m boom 750 tonne super crane for the full construction duration."

The De Beers Venetia Underground Project will replace the existing Venetia open pit diamond mine in the Limpopo Province. By 2021, the diamond bearing ore will not be economical to mine through the open pit method as the amount of waste stripping required will be excessive, hence the requirement for the underground access. In order to extend the life of the mine, De Beers and Anglo American took the decision in 2007 to construct a new underground mine. WorleyParsons RSA has been involved in the project since feasibility stage and was commissioned to execute the detailed engineering design for both the surface and underground infrastructure for the new underground mine, which will comprise a twin shaft and decline mining complex.

Both the production and services headgears are propped towers. They consist of a 12m x 12m x 72m high (production headgear) and a 12m x 12m x 52m (service headgear) braced tower each with a 60° raking leg. A trade off comparison was conducted between a concrete and a structural steel headgear.

The decision was influenced by the time constraints to erect the headgear and the mining method used i.e. having the headgear in place to assist in the sinking condition and then used for the permanent condition (reduced change over period).

Steel proved to be the most practical material as it is quick to erect and the changeover from sinking to permanent will be considerably easier as there are many more openings to remove the sinking equipment and steelwork as well as to bring in the permanent condition equipment and steelwork.

The headgears were designed to be assembled in modules that could be pre-erected and then lifted into place, thereby reducing the need for the 100m boom 750 tonne super crane for the full construction duration. All sheave beams (up 2.2m deep plate girders 11m long) were to be normalized to ensure no residual stresses in the beams after fabrication.

Of the total 1 700 tonnes of steel, 940 tonnes were plate girders, including 290m of 1m x 1m Cruciform columns. This required upfront planning to ensure that all the plate girders could be fabricated to alleviate any delays in the program.

The sheave levels and raking legs were trial assembled in the workshop to ensure that these critical items fitted perfectly together. This proved to be a mammoth task as there were a total of 7 250 holes to be drilled in the sheave levels for the diaphragm plates alone and this could only take place after the sheave levels had been assembled thereby ensuring that the diaphragm plates would fit on site.

PROJECT TEAM

Client: DeBeers

Structural Engineer: WorleyParsons

Quantity Surveyors: DeBeers

Project Manager: WorleyParsons

Main Contractor: Genrec

Structural Steel Detailer/Detailing Company: Genrec

Cipla Distribution Gateway

"To accommodate the tenant's required racking layout, columns were placed on a 38m x 32m grid. The 32m long girders, carrying the 38m long trusses, support a total area of 1 220m^2 resulting in very high forces within the girder and at the connections. Each girder has a support capacity of 120 tonnes."

This project included the constructin of Cipla Medpro main distribution hub for Southern Africa 16 380 m2 warehouse and 1 500m^2 offices facility. A light-weight steel structure was built on 3m high concrete columns on the perimeter and full-height internal concrete columns. Internal columns were founded on pile foundations while perimeter columns have pad footings.The roof structure is comprised of lattice girders and trusses on a 32 x 38m grid spacing.

Eave height of warehouse is 16.5m to accommodate a clear 15m stacking height inside. The warehouse tops out at a maximum height of 22m for the monitor trusses.

A horizontal membrane was created by using a large bracing system over the entire roof area. This membrane is stabilised by strategically placed vertical bracing fixed to concrete portals. Pile foundations under the ends of these portal frames transfer lateral forces to the ground. Trusses span +38m, spaced at 8m intervals, and supports the large HVAC ducts needed to regulate the required temperature for pharmaceutical storage. The loading from these HVAC ducts equates to an additional 3.2tons per truss located at mid-span.

Ecosense was appointed as environmental consultant during construction. Precast perimeter wall panels will result in low maintenance throughout the building life cycle in comparison to painted brick walls. To accommodate the tenant's required racking layout, columns were placed on a 38m x 32m grid. The 32m long girders, carrying the 38m long trusses, each support a roof area of 1 220m^2 resulting in very high forces within the girder and at the connections. Each girder has a support capacity of 120 tons. The requirement from the tenant to control the warehouse temperature resulted in a large duct system from the HVAC plant being supported at mid span of the centre roof trusses. Due to the fast track programme, temporary stability of the structure had to be considered in order to proceed with the installation of roof sheeting and side cladding before the final steel frame was complete. Support of HVAC ducts in and around the warehouse presented additional challenges compared to facilities with traditional HVAC systems. Construction sequence was optimised to allow the various disciplines to complete their parts of the project without causing a delay to other contractors, thus shortening the construction period and finishing ahead of schedule.

Economic steel weights were achieved despite large roof spans (only 8 internal columns) accommodating the racking layout and supporting HVAC equipment.

The project was completed in 8 months, within budget and on time, without compromising on quality of workmanship.

PROJECT TEAM

Client: Capital Property Fund (now: Fortress Income Fund)

Architects: ICM Architecture

Structural Engineer: Bigen Africa Services

Quantity Surveyor: MLC Quantity Surveyors

Project Manager: ICM Architecture

Main Contractor: Isipani Construction

Steelwork Contractor: Anchor Steel Projects

Electrical Engineer: Infrastructure Solutions

Husab Uranium Stockpile

"The project entailed the detailing, fabrication, corrosive protection, delivery and installation of 2 600 tonnes of steelwork, as well as 21 000sqm of IBR sheeting."

The project entailed the detailing, fabrication, corrosive protection, delivery and installation of 2 600 tonnes of steelwork, as well as 21 000sqm of IBR sheeting.

There were a number of interesting challenges to overcome, i.e. short lead times, high specifications required by client, galvanizing of trusses, for the logistical challenges due to cross border distances, lifting and jacking in the 140 tonne gantries and sheeting the building on 45 degree slopes. We pioneered some ideas at each phase to overcome the challenges and ultimately bring the project home safely and in time.

Some highlights were:

- The logistical concern of delivering this volume of steel and sheeting was overcome by partnering with a local transporter with dedicated trucking, supplemented our in-house fleet.
- The development of the idea and plan to strand jack the gantries (50-meter span and 140 tons) into place forty meters above ground level, as opposed to using the traditional method of cranes, allowing for this part of the project work to be done faster and safer, ultimately saving the project time and the client money
- The development of sheeting gondola platforms, which supported a four-man team, tools and materials. These working platforms allowed for the sheeting installation crews to achieve around one thousand two hundred square metres of sheeting installation per day. The safety risk of working on the steep slope was totally eliminated and went a long way in ensuring that Union Steel achieved another incident free project.
- Preassembly of truss box section allowed for the site crews to lift into place bigger sections of steelwork, minimising works being carried out in the air, again target our approach to ensuring that our focus on all projects is safety first, and driven with this mind-set.

The project duration including both on and offsite activities was 14 months with the site duration being 11 months.

PROJECT TEAM

Client: Swakop Uranium (Pty) Ltd

Structural Engineers: HPJV between Amec and Tenova Bateman

Structural Engineers: WAH Engineering (Pty) Ltd

Quantity Surveyors: Professional Cost Consultants

Project Manager: HPJV between Amec and Tenova Bateman

Steelwork Contractor: Union Structural Engineering Works (Pty) Ltd

Structural Steel Detailer: Union Structural Engineering Works (Pty) Ltd

Cladding Supplier: Re Union Projects (Pty) Ltd

Steel Erectors: Re Union Projects (Pty) Ltd

Painters: Nu Nation Protective Coating

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HISTORY IN THE MAKING

with Red Bud's new heavy-gauge cut-to-length/stretcher leveling line

Copy and images supplied by Sian Clarke and Dean Linders

"The new Red Bud line is rated for 1-inch (25.4mm) material at 77 inches (1 955mm) wide and has an 80 000-pound (36mt) coil capacity, with a maximum speed of 200 FPM (60mpm). It can handle high-strength, 72-inch-wide (1 829mm) coils from 16 gauge (1.6mm) up to three-fourths of an inch (19mm) thick at 80 000 psi (551N/mm^2) yield."

In April 2016 a crew from Sian Clarke Communications, a production company with a proud history of providing excellent audiovisual services for the SAISC's Steel Awards, flew to Omaha Nebraska. Their mission? To meet up with Redbud Industries vice President of Sales and Marketing – Dean Linders and capture the milestone achievement in the company's history.

In 2015, Paxton & Vierling Steel built a 200 000 square-foot processing center next to its headquarters just outside of Omaha, Nebraska. The new facility was specifically designed to house a massive Heavy-Gauge Cut-To-Length/Stretcher Leveling Line, built by Red Bud Industries, Red Bud, Illinois, USA. The line, which is one of the largest of its type in the world, integrates a number of unique features and the latest in coil leveling and blanking technology. This includes a Fully Automated Storage and Retrieval System that feeds three sophisticated fiber lasers – a combination found nowhere else in the country.

The new Red Bud line is rated for 1-inch (25.4mm) material at 77 inches (1 955mm) wide and has an 80 000-pound (36mt) coil capacity, with a maximum speed of 200 FPM (60mpm). It can handle high-strength, 72-inch-wide (1 829mm) coils from 16 gauge (1.6mm) up to three-fourths of an inch (19mm) thick at 80 000 psi (551Nmm^2) yield.

The process begins when pre-staged coils are automatically retrieved and loaded onto a Dual Stub Uncoiler. After being unwound, the steel first passes through a Precision Roller Leveler where rolls are used to precondition the strip prior to it being stretched. Next, the strip enters Red Bud's 3 000-ton Stretcher Leveler, which applies enormous force to grip and stretch the strip. Stretching the steel by up to 2 percent exceeds its yield point, thereby equalizing trapped internal stresses that can otherwise cause the material to warp when it is cut, formed, or made into parts. After being stretched, a massive 300 tonne shear is used to cut the leveled material into sheets of various sizes up to 64 feet (19.5 meters) in length. Each of these sheets can weigh as much as 10 000 lbs. (4 536kg) or more. Once cut, the parts are neatly piled in stacks that weigh up to 40 000 lbs. (18 144kg). The combination of roller and stretcher leveling produces material that is perfectly flat and cut and stacked into bundles that resemble a deck of cards.

A shuttle table at the end of the line moves the blanks perpendicularly into an Automated Storage and Retrieval System. The Automated Racking System can store up to 1.4 million pounds (635mt) of steel. Cassettes holding up to 6 000 pounds (2.7mt) each deliver material to three TRUMPF fiber lasers, which cut parts at high quality and high speeds. Once the parts are cut, they are moved by magnetic lifters to Sorting Tables for packaging and shipment.

A big thank you from the SAISC to Sian, her team and her client Red Bud for letting Steel Construction readers share this historical moment.

OPPOSITE ABOVE: Part of the decoil/slitter line.

OPPOSITE BELOW: Coil storage areas.

ABOVE: The rest of the decoil/slitter line.

BELOW LEFT: Unravelling coil.

BELOW RIGHT: Stacking and bundling.

Site storage of cladding materials

by Dennis White, Director, SAMCRA

The consequences of not protecting galvanized coated materials stored on construction sites is relatively well known to roofing contractors and to a lesser degree builders. However, there appears to be a distinct lack of knowledge pertaining to other materials such as 55% Aluminium/Zinc (Zincalume, ZINCAL), colour-coated material, aluminium, stainless steel, polycarbonate and GRP (fiberglass). The ingress of moisture between closely packed components manufactured from these materials has a detrimental effect on both their appearance and durability. Damage can occur within 24 hours.

Initially the clear organic coating applied to 55% aluminium/zinc will protect the metallic coating. If the components remain wet this coating will soften, adopt a milky appearance and become permeable. This results in the formation of wet storage staining followed by corrosion of the steel substrate. Colour coated material will react in a similar manner. The backing coat is only a nominal 5 micron thick.

Aluminium components, including those that have been anodized, are equally prone to damage. Items wrapped in plastic are particularly vulnerable.

The interpretation of what constitutes protection is as varied as the colours in a rainbow and mostly inadequate. What is important is that the components are stored (preferably inclined) above a dry surface, kept constantly dry and exposed to free flowing air. It is of paramount importance that components exposed to moisture are separated, dried and exposed to free flowing air as soon as possible.

Bundles tightly wrapped with waterproof materials are particularly vulnerable. Where the covers are draped over the packed items and anchored to the supporting surface, they sweat in the heat of the day. On cooling, the moisture condenses and is drawn between the tightly packed components via capillary action. Where the stacking surface is likely to be exposed to occasional rainwater runoff, the gap between the stacking surface and underside of components should not be less than 200mm. This will enable any condensate to be removed by the free flowing air. Under no circumstances are cladding components to be stored on ground with standing water or subject to ponding. Dunnage used to support the bundles needs to be dry as moisture and sap trapped at the interface will attack the surface of the components. Dunnage should be spaced at not more than 2.0/3.0m centres (depending on bundle mass) and in between individual stacked bundles in such a manner that the load is transferred without damage to the components.

The splayed upstanding ends of bullnosed cladding are probably the most susceptible to storage damage. It is common practice to cover these ends with sealed black plastic which results in the accumulation of condensate at the bottom of the curve.

Moisture is not the only reason to protect cladding materials. The accumulation of dust, debris and other building materials such as mortar etc. can damage the surface. In order to avoid mechanical damage, cladding needs to be stored out of the way of other trades and traffic.

SAMCRA
SOUTHERN AFRICAN METAL CLADDING AND ROOFING ASSOCIATION

www.samcra.co.za

"The interpretation of what constitutes protection is as varied as the colours in a rainbow and mostly inadequate. What is important is that the components are stored (preferably inclined) above a dry surface, kept constantly dry and exposed to free flowing air."

POLASA *assisting with implementation of* power line hardware DESIGNATION

"POLASA has had several constructive engagements with Eskom's Technical, Quality, Commercial and SD&L teams to implement the said designation in its entirety."

by Kobus De Beer, Director, Polasa

POLASA
POWER LINE ASSOCIATION OF SOUTH AFRICA
www.polasa.co.za

POLASA has worked very closely with the DTI for some years to have power line hardware "designated", ie South African local manufactured content specified for government buying.

This resulted on 21st October 2015 in a formal Government Instruction Note issued to all government buyers. It stated that steel power pylons, monopole pylons, steel substation structures, street lighting steel poles, steel lattice towers and masts as well as power line hardware procured for use in SA, must be of 100% South African content. Designation includes all power line hardware components, regardless of the material(s) used. Aluminium fittings and ceramic insulators are therefore included with all the steel and other components.

ESKOM embarked on a local content initiative some years ago by introducing "LAP" lists ("Locally Approved Products"), listing products (and companies) approved to supply power line hardware requirements for both transmission and distribution. Unfortunately, this system was not equally applied in all provinces, and a number of enterprising importers managed to have their products included in the LAP lists, in spite of them being 100% imported!

POLASA has had several constructive engagements with Eskom's Technical, Quality, Commercial and SD&L (Subcontractor Development and Localization) teams to implement the said designation in its entirety. A number of examples of non-compliant imported washers, eye bolts and rod-ends were tabled, indicating the difficulties of inspecting final products. The examples all represented safety critical components.

These engagements have led to POLASA undertaking to arrange industry workshops on clearly identifying the designated power line products (using Eskom's LAP lists and SAP numbers) so that the descriptions (used for procurement) can be edited to include a specific text, which clearly identifies the products to be purchased only from South African manufacturers. The first workshop was very well attended and focused on Distribution products. Others will follow shortly.

A comprehensive list is being compiled for submission and discussion with ESKOM's Commercial, Technical, QA and SD&L representatives.

The objective is to ensure that there can be no confusion from the Eskom buyers, wholesalers and / or suppliers as to which products are designated and which are not. This list will also be widely distributed to all those inside and outside Eskom, including wholesalers and municipalities, to ensure 100% adherence to the Instruction Note.

POLASA is therefore making steady progress in contributing to the stated DTI PPPFA (Preferential Procurement Policy Framework Act) objectives of job creation, to ensure that products are available or can be manufactured locally are not imported.

A clear understanding exists that this does not protect the industry from being uncompetitive and efforts must continue to improve productivity as measured by our ability to export successfully.

SASFA industry meetings and education initiatives:

Keeping the industry informed and equipped to deliver excellent work

By John Barnard, Director, SASFA

www.sasfa.co.za

On 12 May SASFA held its 23rd industry feedback meeting in Johannesburg, in order to keep broader industry informed about the developments in the LSFB market.
The Chairman of SASFA, Mulder Kruger from Trumod, opened the meeting by referring to the challenges SASFA faced in 2006 when formally launching LSFB in Southern Africa. These hurdles have systematically been overcome to result in the rapidly growing acceptance and implementation of this green building method.

Hannes Basson (presented by M Hickers) from ArcelorMittal gave an overview of the market from a steel producer's perspective. Internationally, steel prices are returning to more sustainable levels, but demand will start growing only in two to three years' time. A growing number of countries were introducing measures to counter the unsustainably low priced steel imports from China.

The current status of the light steel frame industry was discussed by John Barnard, SASFA. Excellent exposure is being maintained in the media, highlighting new LSF projects, training programmes and other industry events. The clay brick industry continued to attack innovative building technologies in the media, illustrating their concern about the threat to masonry building practices.

Training courses were presented regularly, aimed at LSF building contractors and developers, and the professions (architects, engineers, QS's). SASFA is ready to roll out the certification program for builders. Based on a recent survey, manufacturing of LSF increased by 10% during 2015 compared with the previous year, with most of the growth going into LSF roof structures – mainly replacing timber. Some 50% of LSF buildings were in the residential market, with 30% going into office and commercial buildings and the rest into schools, clinics, hospitals and student accommodation.

Two SASFA members presented an overview of two major LSF projects; the external cladding for the Mall of Africa in Midrand, and a 4 500sqm double storey clinic in Swaziland.

The evening cocktail session provided an excellent opportunity for networking. Similar meetings are being planned in Durban and Cape Town.

LSFB training courses for designers, developers and material suppliers

SASFA is presenting two one-day training courses during June 2016. The first is a course on SANS 517, the building code for light steel frame building. It is aimed at all involved in LSFB, from architects, engineers and quantity surveyors through to developers, building inspectors, builders and material suppliers. Completion of the course will enable all practitioners to correctly design and specify LSF buildings, according to SANS 517. The course is presented by Mike Hull, Hull consulting, and John Barnard, SASFA.

The second course is aimed at structural designers. It covers theory of cold-formed steel design to SANS 10162:2, with focus on the effective width and Direct Strength methods of analysis. Completion of this course will enable attendees to design structures using thin walled cold-formed steel sections – essential for design in LSF.

Contact Debbie at 011 726 6111 or Debbie@saisc.co.za for further information.

Excellent exposure is being maintained in the media, highlighting new LSF projects, training programmes and other industry events

Artful STEEL

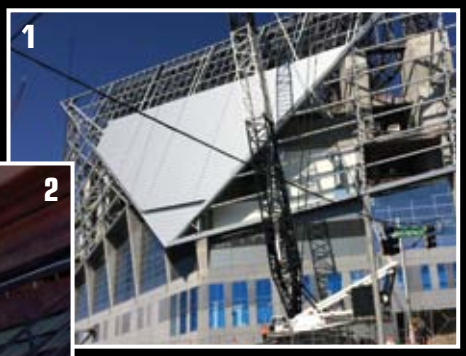
Pictures are worth a thousand words so allow me to use this photo essay to illustrate my more recent encounters with steel art.

By Amanuel Gebremeskel, The 'roving engineer'

Steel is surely the material of choice for iconic structures. It is fitting that artists the world over choose steel to celebrate the Iron Age. Important gardens, shelters, bridges and places of assembly continue to be framed and adorned in steel.

Pictures are worth a thousand words so allow me to use this photo essay to illustrate my more recent encounters with steel art.

1. **The Mercedes-Benz Stadium in the city of Atlanta. This stadium, which is still under construction, will be dressed in steel and feature an impressive petal-like retractable roof.**
2. **Architecturally finished steel is used decoratively across a Minneapolis atrium and within the handrails to give an airy feel.**
3. **Large steel tubes with a patina of rust are used to enhance the aesthetics of a garden in Chapel Hill (background photo).**
4. **One of Santiago Calatrava's greatest achievements is this new winged transportation hub in New York. This piece of art has entirely redefined the World Trade Center.**
5. **There is simply no other way to shelter the great spans required to support Michael Jordan's varsity basketball team.**
6. **A futuristic pedestrian bridge found in the midst of Silicon Valley.**
7. **One of the most iconic uses of steel is in our own backyard. Care to guess where?**



Industry NEWS IN BRIEF

Customised welding cost calculator, an Air Products innovation

In today's current economic climate, the trend is for large manufacturing organisations is to consolidate work areas, which makes for more economical gas usage. However, it is sometimes a challenge to forecast gas volumes and to calculate the most cost-effective long-term usage. To this end, Air Products' Welding Specialist, Sean Young makes use of a customised welding cost calculator, an Air Products innovation, which assists the customer in making the planning process.

Young spends much of his time advising customers on how their choice of gas mix can have a profound impact not only on the weld quality, but on long-term cost-effectiveness.

"Sometimes it can take a bit of convincing that the cheapest option is not always the most cost-effective. But for a customer who is looking to make sensible long-term decisions, choosing the best gas mix for a specific procedure can save money and increase efficiencies in the long run," says Young.

"As an active gas, carbon dioxide used to be the gas of choice – and while it can be effective for a faster and deeper weld, because it is quick freezing, it tends to cause spatter. Using a mixture of active and inert gases, such as our Magmix 3 can reduce post-weld activity – leading to a better weld for the long-term."

Choosing a gas mix depends entirely on the type and thickness of the metal to be welded. Air Products supplies argon for TIG (tungsten inert gas) welding of aluminium, copper, mild steel and stainless steel, and an argon mix for thicker aluminium or copper.

"At Air Products we are passionate about providing a service which goes far beyond supply of product. We provide a close analysis of specific requirements and match those with recommendations on the correct welding procedure, shielding gases and filler material."

Most exciting opportunities now lie in deep-level mining

A blend of people from different generations, together with a wealth of experience and new ways of thinking, allows Hatch to tap into leaner mining solutions for the mine of the future, asserts Kevin Seyfried, director mining AEM, associate at Hatch.

"Our drive towards digital mining solutions brings focus not only to capital optimisation, but also towards improving operating costs. Our mining and minerals processing expertise, together with our operational performance expertise, allows us to add value to clients' bottom line by concentrating on the business lifecycle," Seyfried elaborates.

Depending on the specific client requirements, Hatch focuses on safe and speedy ramp-up, reliable equipment and achieving a stable operational state, in addition to operational improvement and value generation.

"We do work ranging from large capital projects to operational improvements. We have designed underground deep-level mines for some of the most challenging ore bodies in the industry. Our experience in the deep-level mining, dewatering, hoisting and refrigeration spheres, and other typical underground solutions, have allowed us to become an industry leader in these areas," Seyfried points out.

"Some of our most exciting opportunities now lie in the deep-level mining space," Seyfried highlights. As the environment gets less safe and less conducive for people to work in, innovative solutions have to be developed, especially, but not limited to, narrow tabular ore bodies.

BELOW LEFT: Air Products' welding specialist – Sean Young.

FAR RIGHT: Hatch is developing technology for the mine of the future.

BELOW CENTRE: The main shaft at Impumelelo. Hatch focuses on leaner mining solutions to cut costs.

BELOW RIGHT: Kevin Seyfried from Hatch.

ABOVE LEFT: Mareta le Roux, Brand Manager for Plascon Industrial.

ABOVE CENTRE: Kansai Plascon Protective Coatings up close.

LEFT: Corrosion protection helps mines conserve assets.

ABOVE RIGHT: Rio-Carb's welding maching joins two rolled halves of the pipe by welding them together.

These include digital mining, remote controlled operations, autonomous equipment, rock cutting, non-explosive mining and low to ultra-low profile equipment. "We also have internal technology projects which will allow us to take the mine of the future to the next level," Seyfried concludes.

Turnkey protective coating solutions for the mining industry

Over the years, Kansai Plascon has developed fundamentally strong relationships with some of the largest names in the global mining industry. Brand manager for industrial coatings, Mareta le Roux believes that this will work to the company's advantage, when promoting its protective coating range. "This is already bearing fruit, as a large gold mining operation with mines in East, West and Central Africa now specifies Plascon Protective coatings for all of its processing plants. We have also been supplying products to mines in the Zambian copper belt for a number of years. Further expansion in Africa holds the potential for measurable growth."

Corrosion protection is expensive to apply, and le Roux indicates that it is essential to successfully complete the application of the coating on the first attempt. "Bearing this is mind, we provide extensive training to mining contractors at no additional charge. It's all about the customers' bottom line at the end of the day, and we are there to ensure that everything goes according to plan."

"Mining companies are moving towards optimising and conserving their assets, rather than replacing them with new ones. As a result, our sector sales have improved, and I am confident we will gain market share in the foreseeable future."

Kansai Plascon also boasts a strong network of distributors in Sub-Saharan African regions such as Namibia, Botswana, Zambia, Malawi, Zimbabwe, Mozambique, with plans to expand the network in East Africa and West Africa. This network will enable the company to deliver its range of products in the quickest turnaround times.

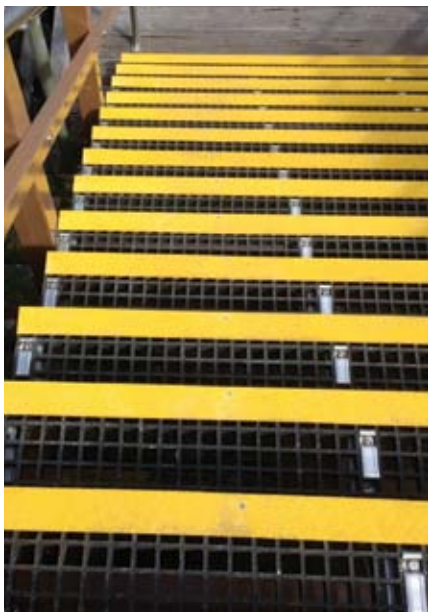
Innovative new welding machine increases efficiencies

In an effort to improve efficiencies and deliver quality products to customers ahead of time, Chromium Carbide (CrC) liner plate expert Rio-Carb has invested in a superior welding machine that has enabled the company to deliver 1km worth of its standard RC700 overlay pipeline to a power generation plant.

The pipes are used in the power generation process at the plant for de-ashing. Coal and pulverised fuel go through burners and generate power and energy. After the process the material turns to ash, which needs to be removed from the plant through the pipes.

Rio-Carb director Colin Maine explains that the machine to manufacture the pipes was locally made and designed according to the requirements of the company. "Discussions about parameters and specifications for the project were first held two years ago and were finalised early this year. It will take six months for the manufacturing process to be completed and we have already started to deliver some of the pipes."

The machine joins two rolled halves of the pipes by welding them together and the plasma cutting machine cuts the raw pipes into various segments and fabricates them accordingly. This modular welding unit will add onto the company's existing machinery and make the manufacturing process more efficient, quick and the welding more accurate. The manufacturing



ABOVE: Vital Engineering's stair tread and gratings.

of the pipes will be completed in May 2016. The company is also tasked with supplying flanges, bends, intersections and other key pieces for the project.

According to Maine, Rio-Carb's overlay pipes are made using a unique method. "The pipes are cut into two halves and bonded together through a specialised AWS (American Welding Standards) welding procedure. Our clients appreciate the superior quality of the pipes and Rio-Carb's manufacturing techniques that fit in with their delivery schedule and requirements."

The custom-made welding machine, which can do horizontal welding and joints, complements the company's plasma cutting machine, which is high definition and works within 1mm of accuracy, and boasts an innovative database program for all diameters.

Mine walkway safety assured with 'Vital' floor gratings and handrails

"When it comes to safety in mining operations, there is no room for guesswork. That is why we ensure strict material controls for our products, which results in the benefits not only of minimising lost time injuries (LTIs), but of long life-cycle or LoM (life of mine) and low maintenance costs," says Dodds Pringle, Managing Director at Vital Engineering and Angus McLeod. The company, established in 1939, specialises in a range of fully serrated, multi-directional non-slip floor gratings and stair treads, providing a durable, corrosion resistant and aesthetically pleasing solution for its customers. Under the brand name Vitagrid®,

Vital Engineering's fully serrated gratings have been used extensively in large and small mining projects over many years.

"We receive positive feedback from these installations in terms of significant reductions in the number of accidents caused by slippage. This equates to a reduction in the number of employee compensation claims and the resultant downtime," Pringle notes.

As a systems-driven and solutions-based company, Vital is not merely product-driven, or just a manufacturer or supplier. Rather, the company's decades of experience and innovation have led to the production of products which constantly meet the changing requirements of industry. A case in point is its exemplary top fixing patented grating panel clips, designed for light, medium and heavy applications.

Informed by systems design which meets specific customer requirements, Vital Engineering also prides itself on the provision of a full consultation service. Being closely involved in the design phase of a mining or construction project, the company is able to offer expert advice when it comes to material choice and design parameters, ensuring fit-for-purpose performance and maximum safety. The company cautions its customers against making ill-advised choices of material which could be solely based on price and which may compromise human safety.

"Contractors and customers need to be aware of the dangers of cutting corners with respect to quality of materials used. When engineers design walkways they do so with specific performance in mind. By replacing this with unspecified material, or sub-standard workmanship, one is courting disaster," Pringle advises.

Vital Engineering's precision-made pressure-forged gratings are manufactured to international standards, using the only the highest grade steel. Floor gratings are manufactured in mild steel, aluminium and fibreglass, with galvanised mild steel a popular choice because of its resilient and hardy finish, according to Pringle. Vital's Maclock® range of handrails has also been developed for safety in applications such as mine walkways, using mild steel, galvanised mild steel and stainless steel.

In addition, Vital Engineering has, in response to the general demand for ease of fitment and versatility, introduced moulded fibreglass gratings and handrails to industry, and has seen a significant uptake, particularly on mining operations.

"Fibreglass is anti-corrosive, fire-retardant, non-conductive, non-slip – and virtually maintenance free," notes Pringle. "As a viable alternative to steel, our fibreglass stair treads, walkways and gratings – under the Vitaglass® brand name – are gaining wide acceptance due to their long-term cost-saving implications and improved safety. They are particularly suitable in harsh, outdoor or highly corrosive conditions.

Vital Engineering's Vitex® range of expanded metal products is manufactured in mild steel, stainless steel and, if requested, more exotic materials. The company also recently launched its non-slip, serrated expanded metal walkways for conveyors and narrow, low walkways (of up to 800mm wide).

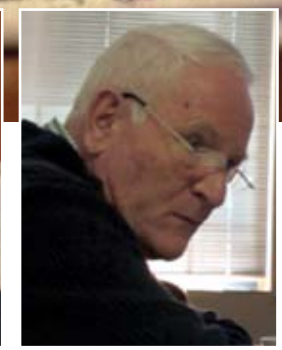
In addition to its many decades of successful supply of handrails, stair treads and gratings to the local and pan-African mining sector, Vital Engineering has also been closely involved in supplying these products to numerous local and international high-profile power generation projects.

This includes the recent supply of bespoke components to Medupi and Kusile local power generation projects, comprising of 8 000 tons of grating panels, approximately 70km of hand railing and over 9 000 stair treads. This effectively makes it the largest gratings, handrail and stair tread supply contract to be undertaken in Africa.

"Vital Engineering is not a new contender to the power generation market and has supplied many other local power station projects such as Arnot, Komati, Koeberg, Kendal, Matimba, Majuba and many others. Our accurate fabrication and fitment systems ensure high quality work associated with world-class suppliers, reducing downtime, on-site costs and delays," says Pringle.

STEEL AWARDS 2016: Ready, Set... Judge!

by Denise Sherman, Marketing Manager, SAISC


The amount of work that goes on behind the scenes of Steel Awards is astounding! Effort is expended all around, from completing the project entry forms (we hear your groans nominators!) to the collation of entries and presentation development for judging. This year we'd like to give our readers and members a bit more insight into the magic that makes Steel Awards possible.

On the 16th of May, our panel of judges met at the SAISC, for their first introduction to 2016's Steel Awards entries. Over a full day they examined the submissions, viewed project images, discussed technical aspects and lauded innovation and workmanship. This initial meeting forms part of a thorough judging process, including short listing and selected site visits.

This year's judging panel consists of Louis Breckenridge (CEA), Dennis Nash (JSD), Franco Mordini (ASTPM), Prof. Alex Elvin (WITS), Garry Powell (LSFB Industry), Johan Nel (SAISI), with support from John Barnard (SASFA), Spencer Erling (SAISC), Paolo Trinchero (SAISC), Marle Lotter (SAISC) and Denise Sherman (SAISC).



BSi STEEL, confirmed the TITLE SPONSORSHIP for STEEL AWARDS 2016

The annual Steel Awards, currently in it's 35th year, is a great platform for rallying the steel industry players and showcasing the excellent work being produced by the industry.

ABOVE LEFT AND RIGHT: First Steel awards planning session at BSi Head Office in Kliprivier.

RIGHT: Lawrence Kelly from BSi.

BELOW LEFT AND RIGHT: BSi head office, naturally made with BSi Steel.

BSi Steel Limited is publically listed steel company headquartered in Johannesburg. The company was established in 1985, listed on the Johannesburg Stock exchange (Alternative Exchange) in 2007.

During a recent visit to the BSi Steel head office in Kliprivier, the team from SAISC had an opportunity to meet for a quick Q & A session in preparation for the BSi Steel Awards, in September later this year. BSi Steel 's CEO, Craig Parry and Lawrence Kelly (Roofing Sales Manager) were able to answer a few of our questions.

Q What do you think the challenges and opportunities are facing the industry?

A: Due to the volatility of steel as a commodity, BSi Steel has made strategic decisions to adapt in this tough trading environment.

ABOVE: The BSi team.

LEFT: The Steel Awards sponsor lunch, where it all started!

BSi Steel has placed itself in a strong position to gain increased market share, through its commitment to customer support, it's well-established footprint, state-of-the art facilities and their ability to act quickly to customer needs.

At last government are taking seriously the impact of cheap subsidised steel, from regions such as China and the likes, hopefully this will result in a more stable steel environment and of equal importance, safe guard industries which are critical, for both growth and job creation in South Africa. Importantly the decision that government is promulgating to use locally manufactured steel in manufacturing sectors will significantly accelerate the country's growth, development and sustainability.

Q: Why did BSi Steel decide to get involved in Steel Awards?
A: BSi Steel is proud to be the new title sponsor for this unique event, it is a good fit, and we are serious about steel, we have chosen this event to demonstrate our support in the steel industry. We are looking forward to a superb event on the 15th September 2016.

Q: How is the BSi Steel "Flavour" going to translate into the Steel Awards?
A: The SAISC team, presented us with the 60's theme, which carries great significance for them, BSi Steel hope to bring new energy to the table, one that we as a company embrace. The BSi Steel Awards evening, promises to be a spectacular event.

For a behind the scenes look at our first Steel Awards planning meeting with BSi visit the SAISC Youtube page:
http://ow.ly/W69U300m5uq

CALENDAR OF *Courses* and *Events*

JUNE

1	SASFA, SANS 517 Course (JHB)
2	SASFA Engineers Course (JHB)
2 - 3	Industrial Buildings Layout Course (JHB)
21	SASFA, SANS 517 Course (DBN)
22	SASFA Engineers Course (DBN)
28	SASFA SANS 517 Course (CT)
29	SASFA Engineers Course (CT)

JULY

21	Member Breakfast (JHB)

SEPTEMBER

15	Steel Awards (JHB, DBN, CT)
16	Steel Day
26 September – 1 October	SASFA Builders Course (CT)

OCTOBER

6	Member Breakfast (JHB)

NOVEMBER

3	SAISC AGM (JHB)
7	POLASA AGM (JHB)

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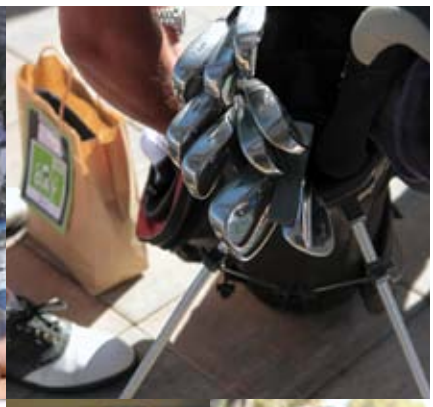
SAMCRA: dennis@saisc.co.za

SOCIAL SNIPPETS:

By Marlé Lötter, Events Manager, SAISC

SAISC Golf Day (JHB)

20 April 2016 – Bryanston Country Club



This annual networking event was once again very well supported both by sponsors and players – 28 fourballs and 112 players representing at least 48 different companies (not counting all divisions). With fairly heavy rain around Johannesburg on preceding days, this event was blessed with blue skies and good times all around!

Competition results:

Winning team: Stewarts & Lloyds – Michael Anley (Host), Pieter Greyling, Dino Spinazee, Richard Harsley (Score: 102)

2nd place: Tudor Engineering – Bram Beukes (Host), Shaun Diggeden, Bruce McKenzie, Wessel van Jaarsveld (Score 96 C.I)

3rd place: Voidpro Manufacturing – Kennedy Jimba (Host), Andries Botha, Stpes Enslin, Kyle van Rensburg (Score: 96 C.O)

4th place: Afrox – Vicus Meyburgh (Host), Glenn Budler, Andrew Winter, Rob Wilmot (Score: 91)

5th place: Macsteel Special Steels – Peter Francis (Host), Graham Skeen, Jose Gallo, Leon Human (Score: 88)

Nearest to pin on:

9th: Shaun Diggeden (Team: Tudor Engineering)

11th: David van Staden (Team: Tricom Structures)

14th : Colin Kirkland (Team: Spiral Engineering)

Longest drive on 8th: Clive James (Macsteel Tube & Pipe)

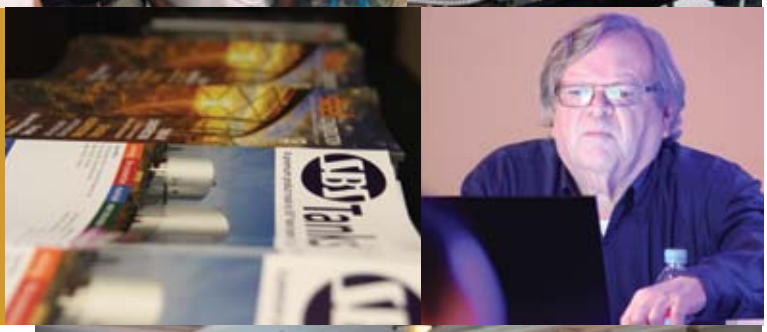
The SAISC proudly acknowledges all the event sponsors:

BSi Steel – main sponsor
ArcelorMittal / Robor / SSAB / Vital Engineering / TüV Rheinland Inspection Services / Macsteel / Tudor Engineering

The Basics of Steel Course

10 May, Sunnyside Park Hotel – JHB

The 1 day Basics of Steel Course was presented by Spencer Erling and Bruce Saxby on behalf of the SAISC. Attendees gained insight into the chemical properties, manufacture process and use of steel in structural applications.



SAISC Member Breakfast

(Jointly hosted by ArcelorMittal South Africa)

18 May 2016, Johannesburg Country Club Auckland Park

The breakfast was a resounding success, with an eager crowd of approximately 140 attendees. Ulrich Joubert from BER and Dean Subramanian from ArcelorMittal shared some insight into current market conditions and challenges. Attendees were encouraged to engage in robust, respectful debate.














Be careful who you contract with - *you could pay back if your counterparty is liquidated*

By Taryn van Deventer, Senior Associate at MDA Consulting

"Business closures of contractors in the construction industry are rising at a rate of five liquidations a month. Against this backdrop, contractors and sub-contractors are being warned that payments can be clawed back from them if their contracting counter-party winds up in liquidation and certain criteria are met."

Business closures of contractors in the construction industry are rising at a rate of five liquidations a month. Against this backdrop, contractors and sub-contractors are being warned that payments can be clawed back from them if their contracting counter-party winds up in liquidation and certain criteria are met.

In addition, upfront payments to a contractor before the commencement of a project may be viewed by a liquidator as a payment made when the employer was in fact insolvent (de facto insolvent). This would allow the liquidator to unwind that upfront payment through the court.

This situation is not uncommon and extends to work completed, invoiced and paid at a time when the debtor is insolvent on account of liabilities exceeding assets after making the payment if the intention was to prefer one creditor over others.

The bottom line is that you need to be very careful with whom you choose to contract. Ensure that the business or individual is financially stable enough to fund the project, or has backing from a financial institution.

If your contracting counterparty winds up in liquidation, the funds can be demanded from you if the requirements of Section 29 of the Insolvency Act are met. All that needs to be proven by the liquidator is that, at the time of making the payment, the debtor was in fact insolvent and the intention was to prefer the party receiving the funds over other creditors.

One way to mitigate against this risk is to ensure that you are aware of the financial intricacies. Make sure you have done your due diligence on who is financing the project and whether there is a funding arrangement in place. You may want to consider requesting security for payment. Although standard form contracts don't specifically cover such security, where you foresee risk, you should request payment security – subject, of course, to the commercial realities of making a deal and being appointed on a specific contract.

Taryn completed her studies at Rhodes University. She is an admitted attorney and a member of the Law Society of the Northern Provinces.

Taryn has a broad range of commercial and dispute resolution experience in both domestic and international construction and mining projects including general commercial advisory, specific contract negotiation and drafting, litigation, arbitration, mediation and settlement of disputes. Taryn has managed large-scale disputes from inception to settlement for entities listed on the JSE and internationally as well as large unlisted companies, advising on all aspects of dispute avoidance and resolution. Taryn joined MDA Consulting, a specialist commercial advisory practice in the construction environment, in 2014.

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