steel CONSTRUCTION

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IN THIS ISSUE:

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OFFICIAL JOURNAL OF THE SOUTHERN AFRICAN INSTITUTE OF STEEL CONSTRUCTION

EDITOR'S NOTE

You've all seen these social media scary statistics haven't you? Well if not, I will give you the short version. I am Generation X and though many of my generation have embraced social media there is also a substantial group who had the same preconceived ideas as I had.

It's a fad. It's for the young bored Generation Y's and Z's. It is all about self importance and it will blow over.

But this is the reality: (the shortened version – for the funky long version go to *http://www.youtube.com/watch?v=3SuNx0UrnEo*

- If Facebook was a country it would be the third largest country in the world.
- A new member joins Linkdin every second.
- 50% of the UK's mobile internet traffic is for Facebook (the clip adds: "imagine what this means for bad customer experience?").
- Generation Y and Z (the group of people born between the early 1990s and the early 2000s) consider email passé – some universities have stopped distributing email accounts.
- eReaders have surpassed traditional book sales (am I now a dinosaur for preferring a printed book?)
- If Wikipedia was made into a book it would be 2.25 million pages long and will take you over 123 years to read (I assume you have to be a fast reader)
- 90% of consumers trust peer recommendations – most of them through social media.
- 93% of marketers use social media for business. The question is – if you don't will your business still exist in 5 years?

So, the Institute decided to use social media as a theme for Steel Awards this year for the fun side of it. But we also want to motivate our members and the broader steel construction industry to take note of this phenomenon, re-think their brand positioning and join the party.

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Contents

The Steel Construction journal supports the freedom of media and speech implicitly enshrined in our Constitution (Article 16).

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INDUSTRY NEWS IN BRIEF

A SOUND INVESTMENT: High-tech cranes give Cosira Group (Steel Awards 2011 Partner Sponsor) a lift

The Cosira Group has recently made a massive investment in the purchase of a number of state-of-the-art cranes. The new cranes include the biggest crane the company has invested in to date, the SCC4000, a 400 ton crawler crane from the Chinese company Sany.

In the wake of a contract awarded by Eskom to the Cosira Group in consortium with Alstom earlier this year to complete the construction of South Africa's first wet flue gas desulphurisation (WFGD) system in Eskom's Kusile power station, it had become necessary for the company to invest in cranes with substantially increased lifting capacity.

The boom of the SCC4000 operates according to different combinations. The main boom's operating capacity reaches a height of 110 metres, with a 92 metre working radius. Using the main boom, luffing jib and superlift mast, the operator can reach a boom height of 168 metres with an 84 metre working radius.

"We believe in making sound investments in equipment and technology to increase our overall operational effectiveness and minimise process risk", says John da Silva, CEO of the Cosira Group. "Owning our own fleet allows us the flexibility to give our clients the best service."

"Such a flexible yet robust machine is essential for our operations going forward. A major investment such as the SCC4000 is pivotal to our capacity to offer optimum service and operational excellence," concludes da Silva.

John da Silva, CEO of the Cosira Group.

DO NOT SLIP UP! The importance of walkways and handrails in the water processing industry

The environment at water and wastewater treatment plants is inherently prone to the presence of moisture. This naturally creates safety hazards for personnel, in the form of slips and falls which can lead to minor injuries at best – and even loss of life, in the worst case scenario. Preventing these slips and falls is a constant challenge to the industry, and one which is highlighted as of major concern and importance to risk and safety officers.

"Tackling the risk surrounding working in wet and corrosive environments is best approached with a three-pronged plan. Firstly, anyone walking around the plant should be informed through an education and awareness pro-gramme about the on-site risks and how to alleviate or eliminate them. Secondly, suitable safety equipment, such as non-slip footwear, should be provided to employees and visitors moving around site. Finally, suitable measures should be taken to install adequate and OHSAS compliant walkways, stairs and handrails," Dodds Pringle, MD of Vital Engineering (Steel Awards 2011 partner sponsor) advises.

Furthermore, he points out that, as exposure to OHSAS regulations has become more pronounced, the company has seen an increase in the call for high-quality products which are engineered to suit the arduous conditions at desalination plants,

Non-slip footwear and OHSAS compliant walkways prevent accidents at water processing plants.

INDUSTRY NEWS

municipal sewerage plants, water purification plants, water treatment plants in paper and packaging industries, mine washing plants, power station cooling towers, dams and pumping stations.

"We place great emphasis on designing for safety. This means that when the installation is for an industrial application, we design with 350WA steel. The use of this grade of steel naturally affects the design we implement, with the platforms that the walkway rests on being placed further apart than if we were specifying a lower grade or commercial steel," Pringle says.

Pringle points out that a full risk and needs analysis has to be performed before a particular product is specified for the application at hand. "We need to ascertain, in advance of supply and installation, factors such as anticipated volumes of traffic, presence of water and chemicals expected to spray or fall onto the product. This would include products such as Vitagrid fully serrated non-slip surface stainless steel, aluminium or galvanized mild steel safety gratings, stair treads and handrails; as well as Vitaglass UV-resistant non-slip fibreglass gratings, stair treads and handrail systems."

"Whether a customer uses our steel or fibreglass products, we can offer fully tailored to drawing gratings, stair treads and handrails which improve the longevity of the plant, increase worker safety through the non-slip features offered on the flooring products. Lastly, the maintenance costs can be reduced dramatically if the correct product is used in the client's specific environment. All the products offer huge savings from reducing worker injury downtime to reduced running costs of the plant," Pringle concludes.

Jim Kirwan, Cooperheat of Africa RSA operations manager, with Heat Treatment equipment in the Cooperheat workshop.

HEAT TREATMENT TRAINING HOTS UP

The Southern African Institute of Welding (SAIW) reports that the first batch of students recently completed the inaugural course in Heat Treatment and the next few courses are already fully booked.

"Heat treatment is a critical activity in welding and fabrication and the independent training and evaluation of the personnel performing it has largely been neglected up to now," says SAIW executive director Jim Guild.

He adds that there is not sufficient awareness about the importance of heat treatment in ensuring that equipment is suitable and safe for service. "Pre-heating welding operations can be crucial in ensuring that cracking does not occur during welding. Post-weld heat treatment is key in ensuring that the correct strength properties are achieved in a weld and that the weld joint is left free of residual stresses. This stress relief can be extremely important in avoiding catastrophic structural failures and in-service degradation through stress corrosion cracking mechanisms," he says.

Guild emphasises that the SAIW Heat Treatment qualification will enable users to specify the skill levels of heat treatment technicians. "Heat Treatment of welded joints is widely practised, especially in the process and power generation industries and we want to help both the user and the service provider by ensuring that the qualification gives both parties confidence in the personnel performing critical heat treatment operations."

The course is aimed primarily at heat treatment operators performing site and shop heat treatments using electrical resistance heating. SAIW is investigating the possibility of introducing a level two course which would incorporate other heating methods, such as gas and salt baths. "In the meantime the current course includes excellent general information," says Guild.

Guild says he is grateful to Cooperheat of Africa MD Yusef Patel and South Africa operations manager, Jim Kirwan for prompting the SAIW to introduce the course and for the help they have given in getting the course off the ground. "It's a great example of a company wanting to improve the skills of its personnel, being prepared to have them independently assessed and doing a lot more than just talking about it."

ROBOR ACQUIRES THE KMG CARBON STEEL DIVISION

Robor Tube and Pipe has acquired the KMG Carbon Steel Division from the Blackstar Group. This agreement, effective from 1 June 2011 follows Blackstar's decision to divest in KMG Steel Service Centres in return for 5% of Robor's issued share capital. The transaction is said to be worth in excess of R50 million.

The acquisition encompasses the former KMG Vanderbijlpark, Isando and Welkom operations. This division

Gordon Gilmer, CEO of Robor.

known as Baldwins Steel will be part of Robor Steel Services, operating as Robor Baldwins under the leadership of Andrew Winter and his management team.

Baldwins Steel handled more than 108 000 tons of flat steel products in 2010, sourced both locally and internationally. "We are excited about the possibilities that this new venture offers our existing customers" said Gordon Gilmer, CEO of Robor. The firm will now be able to offer a wide range of hot rolled, cold rolled, galvanized and pre-painted, sheet, coil and plate in commercial, certified and wear resistant qualities.

Robor will make additional investments in the new Robor Baldwins, including improvements to the plant that will increase production capabilities. With the company's far-reaching distribution network, strong capital resources, efficient production and robust information systems Robor anticipates being one of the top steel vendors in Southern Africa.

HATCH IMPROVES WORKFLOW WITH IN-HOUSE 3D MODELING CAPABILITIES

Consulting engineering and project implementation firm Hatch's Structural Practice is cutting their project delivery schedules by up to three months and improving quality control owing to improved workflow through its in-house 3D modeling procedures and shop detailing capabilities.

Hatch structural practice lead, Stephen Stacey says that by replacing the 2D engineering layout workflows with 3D model workflows, the result is saving structural engineering drafting hours as well as enhancing quality.

"The schedule for the in-house shop detailing workflow, in comparison to the traditional workflow, affords clients a time saving of between three weeks and three months by cutting out the need for 2D drawings and shop drawing approvals. Through the traditional workflow, companies have to prepare the 3D models and 2D drawings before they can tender and award the shop detailing to a fabricator," says Stacey.

By using the in-house approach, the shop detailing can begin while the fabricator is still in the tender selection process. Once the fabricator has been appointed, they can immediately begin ordering material to begin fabrication rather than wait another eight to ten weeks for preparation and approval of steel detailing documentation.

Hatch's Structural Practice is currently involved in numerous projects, including the Kolomela mine in the Northern Cape for Kumba Iron Ore, a business unit of global miner, Anglo American. As the main EPCM contractor on the project, Hatch's Structural Practice was tasked with the design and engineering of a new plant, primary crusher, secondary crusher, tertiary crusher and train load-out station. Stacey says the project has been running since 2008 and is now reaching commissioning. Amongst others, Hatch's South African and Canadian offices are also involved in large smelter projects in Canada and Iceland for mining giant Rio Tinto.

Secondary Crusher 02 for the Kolomela mine (Sishen South project for Kumba Iron Ore).

SAISC COMMENT

By Dr Hennie de Clercq,
Executive Director, SAISC

I feel there are many things people in our industry can do to make our country a better place, thus giving real expression to 'love thy neighbour'. But we need better direction; we need to feel that we are participants in 'Project South Africa', a project aimed at bringing the country to a high plateau where we can all experience freedom from poverty and ignorance.

ETHICS IN OUR INDUSTRY

I can't remember ever meeting a person who did not want to be recognised as being principled in some way or another. Sure, some people have weird principles, and one reads about people adhering to absolutely horrible ones, but just about every person I have ever met subscribed to pretty decent principles. When it gets to business, morality sometimes becomes rather more fuzzy, and it may be useful to have another look at what would constitute ethical behaviour for a business in South Africa.

The basic driver of our business ethics should always be our fundamental values as human beings. At the basis of this lies the injunction "love others as you love yourself" or then "treat others as you would like to be treated". This covers a lot: don't steal or cheat, be fair, create opportunities for people to advance themselves, remunerate on reasonable levels, look after people's safety and health, don't produce things that are detrimental to people in any way, etc.

In fact, if you take 'love thy neighbour' to its logical conclusion and live strictly by it, most things should fall in place as far as business ethics are concerned. But there are also many things that depend on societal norms that are not so easily reduced to the basic rule. These tend to be rather more fluid. Protecting the environment, for example, has been elevated to an ethical principle during recent decades, whereas when I was young most people thought only about a few things as bad practices such as soil erosion and pollution. The status of women and their role in business and the professions have not only changed, it has come to be acknowledged that it is immoral to confine women to a lesser state. The same has, of course, happened with respect to race, or indeed all the other features on the basis of which people can be differentiated from each other. Safety and health is another aspect that has moved from 'nice to have' to a basic and even emotional imperative.

The laws of the land are based on the morals of individuals and of society and are meant to enforce behaviour that is in agreement with these norms. They go a lot further, however, because in a complex modern society there's hugely more to say about what a simple thing like 'don't steal' could possibly mean in all the diverse situations we find ourselves in as business people. Laws also define new moralities. Think for example of the Competition Act, where many things that we never viewed as immoral (and I am certainly not thinking here about colluding to inflate prices) have suddenly become illegal. I expect the Competition Act to be like the anti-smoking law, which worked like a bomb because society was ready for it. There's a flurry of Competition Commission cases now, but I think the whole thing will soon fizzle out because business people are internalising the values underlying the act and will shun anti-competitive behaviour, except for the dishonest ones.

Another ethic that came to us through law was black economic empowerment. Any right thinking South African should know that the country can only have a future if black people play a big role in the economy, to the point where they cause the economy to grow hugely. But established business needed direction, coaxing and rules to cause them to do the right thing. I think black and white people have not had a real meeting of the minds about this issue and on both sides we are not working hard enough to let it succeed. It's an ethic that has not gained the traction it should have.

I feel there are many things people in our industry can do to make our country a better place, thus giving real expression to 'love thy neighbour'. If the economy grows rapidly we have a chance of wiping out poverty through creating jobs, and hopefully we will arrive at better education for all. But we need better direction; we need to feel that we are participants in 'Project South Africa', a project aimed at bringing the country to a high plateau where we can all experience freedom from poverty and ignorance. We all need to be inspired by the same vision, we need to understand our roles, and we need to believe that we are all working together towards the achievement of a credible objective. Defining such a vision and providing the leadership is clearly the task of government. If that can happen, I can see how behaving in a highly ethical way will come naturally for every right thinking person in industry.

CALENDAR OF EVENTS

SASFA EXHIBITING AT GREEN BUILDING CONFERENCE
13 - 14 July 2011
Sandton International Convention Centre
www.sasfa.co.za

LIGHT STEEL FRAME TRAINING COURSE FOR BUILDING CONTRACTORS
25 - 30 July 2011
Saint-Gobain's offices, Durban
www.sasfa.co.za

VISITING ARCHITECT – TOM KUNDIG
25 August – Bloemfontein
29 August – Cape Town
31 August – Durban
1 September – Johannesburg
www.saisc.co.za

VISITING ENGINEER - LEROY GARDENER
5 September 2011
Gauteng venue TBA

14th INTERNATIONAL SYMPOSIUM ON TUBULAR STRUCTURES
12 to 14 September 2012
London, United Kingdom
www.imperial.ac.uk/ists14

STEEL AWARDS 2011
15 September 2011
Gauteng: Emperors Palace, Kempton Park
Durban: Sun Coast Casino, Durban
Cape Town: The Ball Room, One&Only Hotel, Dock Road, Victoria & Alfred Waterfront

KZN SAISC GOLF DAY
20 October 2011
Bluff National Park Golf Course
Enquiries: lisa.m@chillibyte.com

SASFA EXHIBITING AT GREEN BUILDING COUNCIL CONVENTION AND EXHIBITION
26-28 October 2011
Cape Town International Convention Centre
www.sasfa.co.za

SAISC/SASFA/ISF AGM
10 November 2011
Country Club Johannesburg

SMMH 2012 – STRUCTURES FOR MINING AND RELATED MATERIALS HANDLING INTERNATIONAL CONFERENCE
15-18 October
Gauteng

FOR MORE INFORMATION ON EVENTS VISIT OUR WEBSITE – www.saisc.co.za

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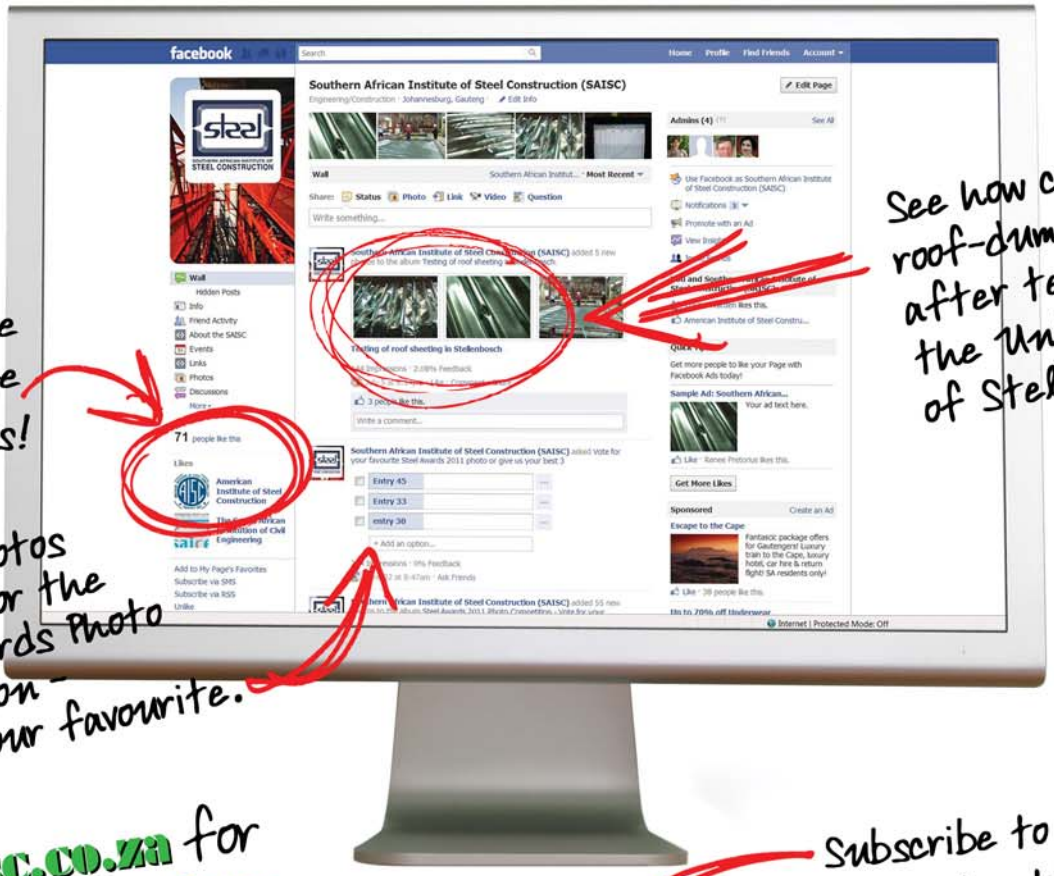

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ISF WARNS OF THE STEEL CONSTRUCTION IMPORTATION PITFALLS

By Neels van Niekerk, ISF Director

South Africans must adapt to current global practices in relation to the increased Eastern imports into the rest of Africa. It is more advantageous to blend our South African offering with Eastern imports than to be disqualified on price alone.

The ISF under the directorship of Neels van Niekerk is known for its extensive interaction with local and international clients as well as structural steel contractors and is increasingly being approached to illuminate the benefits and pitfalls of fabricated structural steel importation into Africa.

In this article Neels shares the ISF's insights into steel construction imports issues and warns of the importation pitfalls to avoid.

South Africans must adapt to current global practices in relation to the increased Eastern imports into the rest of Africa. It is more advantageous to blend our South African offering with Eastern imports than to be disqualified on price alone.

Opportunities for South African companies to import into South Africa are currently very limited due to the applied 15% import duty but through our constant and close contact with Australian-based mining EPCM's the ISF has learned acceptable ways to manage imports into the rest of Africa.

The ISF is confident that these opportunities will grow. The boom period of 2008 is over and in today's globally competitive market, it is logical for clients, EPCM's as well as local structural fabricators, to look for alternatives to augment their offerings, both for local and typically African export markets. Importing from the West comes at a premium rather than a discount, so it is to the East where substantial export subsidies exist, that companies will look. Price quotations of up to 50% discount have been received! (This does not apply to Japanese and South Korean fabricators, so any reference to the East specifically excludes these two countries.)

There are several things to be aware of when importing from the East. One of the most important issues is the difference in contracting and fabrication practice in the East. Due to the bulk of projects today falling into the 'fast-track' category, local engineering houses and structural fabricators have developed sophisticated systems to handle updates and modifications. This 'design-as-we-fabricate' practice remains largely unsupported in the East where this is typically viewed as 'undisciplined' engineering. There, when modifications are sent through to the fabricator, they will often suspend fabrication until the impact of the modification is fully understood and the project re-priced. When contracting with the East, it is undoubtedly the best to have a contract based on agreed, fully-detailed factory drawings.

The best pricing will most probably be on exact 'cut-and-paste' repeat projects like 'another thermal power station like this one'. This concept is foreign to the South African thinking and the difference, for example, in the capital cost per MW of Chinese thermal power stations as compared to the current SA power stations being built, is substantial.

Another major difference relates to the differing perceptions of quality. Importers must carefully study the quality issues and devise strategies to manage them. The quality culture in the East regarding steel mills and structural fabrication differs vastly from our local culture. In the East steel qualities vary significantly from region to region and even from factory to factory. Also, in countries where low-cost labour is available everywhere, rectification costs on site are low. This differs greatly from our own rectification costs on mining sites and in Australia (up to R1 000 per hour) and Canada (up to R700 per hour) on-site rectification is an absolute no-no.

The ISF recently visited China to gather information on how their import/export processes really work.

The ISF suggests that it must be contractually specified that only certified prime steel directly from specified first-class steel mills may be used. It is common practice among larger international project houses to include the requirement that any structural steel of 20mm thickness and higher may only be sourced from specific mills in Korea, Japan or Germany.

Another critical issue relates to price and the ISF warns that new importers often fall into the trap of looking for the biggest difference between foreign quotations and local prices and basing their judgment solely on that. This is a sure way to disaster as many will testify. Exceptional diligence should be exercised when selecting a fabricator and price should definitely not be the only factor. In China, for example, the best fabricators are undoubtedly those belonging to and supervised by well-known Japanese and Korean owners. Others, except perhaps those owned by first-class steel mills, should only be considered after major due diligence has been undertaken. Due to recent failures in South Africa, one of our major mining houses now rejects any structure found to contain imported primary or fabricated steel unless it has been cleared beforehand.

The issue of delivery dates must also receive special attention. The penalty system in South Africa for late delivery is generally accepted and well understood. If a client requires a delivery date and the fabricator believes that this date cannot be met, it will reject the order regardless of how dearly they want it. In the East, the client is assumed to be the expert and orders will be accepted despite the fabricator's own estimates. When deadlines are not met, penalties are not accepted as the fabricators do not believe they have done anything 'wrong'. Even if it takes longer than originally agreed blame cannot be apportioned, and insisting on penalties will not only not help but will also almost certainly halt production.

Legal issues are yet another area where things are vastly different and importers must understand that civil courts as we know them seldom exist in the East. While South Africans typically accept the written contract as the basis of agreement, in the East the written contract is viewed as the starting point and forms only the basis for further and continuous negotiations. The fabricators will not view themselves liable if they misunderstood the contract and, in practice, the buyer has no legal recourse.

Special attention should be paid to the actual pricing agreement. Pricing per ton based on South African design must be avoided. Eastern fabricators will substitute their next heavier available sections and the net weight will be typically 10 to 15% higher. Also, initial Eastern pricing typically excludes items such as detailing, shot blasting, priming and painting. Owing to language barriers misinterpretations often occur and the buyers will be required to accept the costs for the additional processing. In short, if you are planning to use Eastern fabricators, obtain their 'Red Book' and design accordingly.

There are clearly many things to take into account when importing from the East as it is a complex process and South Africa can learn from the Australian EPCM's which were the first to explore the route of cheaper Eastern imports and are the experts in this field today.

They very soon learned the hard lesson that the only way to overcome the difficulties and ensure steel structures are manufactured to established standards, is to place permanent staff at Eastern fabricators and this is perhaps an option that our industry should seriously consider in future.

KALTENBACH IPS 2011

By Spencer Erling,
Education Director, SAISC

Spencer recently had the opportunity to visit the IPS at Kaltenbach's factory in Lörrach, Germany. In the first of two articles, Spencer discusses what Kaltenbach had to show us. The second article which follows in the next issue covers an overview of the other exhibitors.

Bandsaw machine – mitre cutting and CNC controlled.

During the latter part of the last century, the Kaltenbach name in the structural steel industry became synonymous with big, almost everlasting circular saws. In time they moved into NC drill lines and band saws.

But of late Kaltenbach have expanded their programme and are now regarded as being one of the top companies selling equipment and technology for 'metal processing'.

Needless to add the handling/feeding systems are made as automatic as required to suit the particular customer and in all cases minimises labour input and are purpose-designed to integrate whatever handling and machines that are required by the customer.

At IPS2011 (International Partners in Steel) some 19 South Africans involved in fabrication were treated to see for themselves state-of-the-art applications of the equipment at Kaltenbach's Lörrach factory. In addition some 30 plus other partner companies displayed their equipment, technology and or software.

What an amazing concentration of see-it-all-in-one-place opportunity for those of us lucky enough to see it. For those of you who were considering the

Drilling machine – drill change unit.

Circular sawing – horizontal saw.

trip and then pulled out, you just do not know what you missed. For you and others who had not heard about the IPS, 2013 is not far away - make the effort to go you will not regret it. Buying state-of-the-art equipment is not a quick think and spend decision. A visit to IPS will plant the seeds for future harvesting, but will also give you a great picture of what you can do over time in your own works environment. Entry level is surprisingly cheap if you consider the potential return.

Not only do you see machines set up to show off the latest developments, but perhaps even more importantly you see Kaltenbach's own works, how they use their own equipment, and their amazing logistics and storage systems for a myriad of work in progress components. And, in and amongst all of these components and machines, you would quite happily sit down and eat your lunch off the spotless clean floors. South African fabricators, take a wakeup call and if nothing else learn to keep a clean workshop!

SO WHAT DID WE EXPERIENCE?

And we thought South African hospitality is warm! Yes it is, but for sure our German hosts needed no lessons in that regard. Apart from the warm welcomes, the friendly technically competent sales people, not too pushy, everyone had a "nothing is too much" attitude. We stayed at nice clean hotels, were fed all day long with coffees, cold drinks, juices, beers, snacks, a great lunch and even more impressive theme dinners with excellent entertainment. Kaltenbach's team just could not do enough to make us and keep us happy whilst in their midst. Thank you!

MORE IMPORTANTLY, WHAT DID WE SEE AND LEARN?

For starters there were enough machines on show either at IPS or in the Kaltenbach works, to get a taste of the capabilities of each type of product covered by Kaltenbachs' 76 page Product catalogue. Clearly there is no point in showing each and every model (there are 31 saw models alone!).

AUTOMATION IS THE NAME OF THE GAME

No matter which machine you look at, nor what combination you are considering, handling costs using old fashioned methods are enormous. Whatever Kaltenbach do with machine development, saving of labour is a key objective. So they will purpose design a handling system which will

Plate processing – gas cutting.

marry the model of machine (as automated to the extent that suits your works) into your own particular flow system, no matter how convoluted. Some of the methods available to choose from and plant layout around include:

- Cross transport using 'drag chains'
- Cross transport using a lift and carry process
- Pusher measuring systems
- Long stop measuring systems
- Auto-sorters
- Long travel feeds

SAWING, DRILLING AND COMBINATIONS

Stand alone saws (more for use in light industry e.g. furniture manufacturers) were available, are quick and can cut at the bevel – all NC controlled.

Coping robot – 8 axis head.

A stand alone model KBS1051 saw was on display and was described as the "fastest saw in the world". I watched in amazement as the machine cut through a HEM400 x 256kg/m European profile (300 x 40 flange, 21 thick web) in 1 minute and 41 seconds (cutting time only). Try beating that with a hack saw!

What really spoke out to me for our industry were the integrated sawing/drilling systems on show. A band saw was in use for this combination. Clamps on the saw blades near to the cutting faces prevent the saw blade from 'running off' and ensure square cuts. To provide maximum cutting speed, the angle of the blade relative to the web of the piece being cut alters automatically depending whether the flanges or the web is being cut. The quality of blade in use is a far cry from the older band saw technology we are accustomed to thus increasing cutting speed and tool life.

The drilling machine was set up with a quick change tooling centre, high speed marking, and provided for complete drilling of short items before cutting the piece to the right length. In my personal experience with second generation drill lines (circa 1979) we were very excited when we drilled 1mm in 1 second. These days complete holes in 20mm thick steel happen in 3 seconds (6 times faster) with much longer life for the drill bits (handled correctly of course). At that speed, correctly planned for the right applications, a state-of-the-art sawing/drilling centre could replace both old type punch and shear and saw and hand drill machines with a more flexible unit.

And, when it comes to drilling, countersinking and thread cutting are possible with the correct tooling in the quick change centres.

WHAT ABOUT PUNCHING?

That does not mean that Kaltenbach do not have punching and punch and shears machines in their programme. They offer two angle punch (or drill)/crop models particularly suited to angles and three punch and shear machines. Of course these models can include quick change tooling centres and automatic blade adjustment to suit thickness being cut and automatic die change to provide the best punch/die combination to suit the thickness – all aimed at providing the cleanest cut/hole possible.

PLATE PROCESSING

It took our industry in South Africa a while to realise that plate processing (cutting and holing) is one of the most important workstations in our fabrication shops. The uptake of this type of equipment has been a bit slow. Wake up guys, this will make a major difference to your production.

Oxy-acetylene, plasma and/or laser models or combinations are available. For the drilling or punching, quick change tooling centres are available. Kaltenbach use such an installation in their shops for cutting and holing the multitude of 'widgets' they need to build machines with. In this instance they have incorporated a robot with magnet attached to the arm to pick up and pack the cut plate in exactly the pre-chosen position, all part of their flow logistical exercise.

COPING ROBOTS

Don't be like me and be fooled by the name and ignore these machines. No, the modern versions of this machine do not only cut notches at the end of floor beams. These 8 axis robotic machines are far more versatile than that

Painting.

Shot blasting.

and can cut plates to size, can single or double mitre edges, cut any shape holes or slots in the web (e.g. service holes, floor beam, webs) and can do castellated beam cutting and then add a few more.

If you are retooling have close look at this – it may surprise you.

WELDING ROBOTS

They have been around for a while. We know installations that weld hundreds of 'standard component' welds a day. But we ignored them because the 'programming' was too difficult for small or one-off quantities.

Not so any more and the programming issues are sorted with an interface to your 3D detailing package. (Now all we have to do is get our draughtsmen to put exact welding details onto their drawings...)

SHOT BLASTING AND PAINTING

I guess I am still a fabricator at heart. Have I saved the cherry on the top for last? Since Kaltenbach purchased Gietart they have been able to bring their concepts into fruition for this last step in the fabrication process.

From a shot blasting point of view they have various models, some ideally suited to blasting before fabrication, or as typically demanded by South African specifiers after fabrication blasting.

All the machines use easily replaceable wear resisting manganese steel liners keeping the machine running time to very high levels. (If you ever tried to replace a liner on an old fashioned model you will know that down time is a major issue.) Built into the machines is a shotblasting abrasive cleaner that ensures that only good quality, dust free abrasive (shot) is used in the blasting process.

Multiple layers of slatted screens at entry and departure sides of the machine keep the abrasive in the machine. Excess shot removal is far more efficient than old methods (I can still remember guys standing on the ends of beams with brooms and shovels removing the excess shot on older models.)

PAINTING CENTRES

This is a field few, if any steelwork contractors have ventured into in SA. Why? I guess we are still fooled into believing we have cheap labour to do spray painting by hand.

If you had the option to buy a painting machine:

- with mechanical feed in and feed out,
- suitable for painting post fabrication assemblies,
- with multiple paint nozzles (typically 12 but up to 24 are possible) that automatically move themselves to be at the optimum distance from the steel it is painting,
- thus minimising paint waste,
- that can use solvent or water based paint,
- that has overcome the problem of blocked nozzles, has a drying chamber with adjustable heat settings,
- can cope with more than one coat requirements from 20 to 150µm thicknesses

Can you see in just how many ways the savings will quickly pay for such a machine? You will not require a painting chamber to conform with safety and health issues. These machines will move the typical South African fabricator's bottle neck away from the paint bay. Of course such machines are integrated with shot blasters.

For more general information contact Spencer on spencer@saisc.co.za. For sales information contact Steve van Wyk at First Cut who ably represents Kaltenbach in South Africa stevev@firstcut.co.za

CADCON (PTY) LTD

By Viv van Zyl,
SAISC Membership Consultant

Cadcon's factories boast the latest technology CNC machinery to provide the highest quality fabrication. The list of high quality FICEP equipment is as impressive as can be. This includes the various types of CNC machines including a combination plasma/ gas plate profiler, angle line, 22m in-feed saw and beam line machines, drilling line, all to ensure high production and quality fabrication.

Richard Butler, Barry Barnard and Johan Jonker.

Cadcon is one of our countries leading steelwork contractors. They started from humble beginnings in 1987, in a garage on a smallholding just outside Pretoria and the company has grown into a steelwork contracting company involved in major projects in and around Southern Africa, such as the 2010 FIFA Mbombela Stadium (in JV with A. Leita) in Nelspruit (Steel Awards Tubular Category Winner 2010) and the recently completed Mauritius Commercial Bank in Ebene, Mauritius.

Barry Barnard and Gerhard Meiring started their one-garage-two-man-business by accepting minor steel construction jobs. Their dream of offering their customers quality and service grew steadily.

In 1995 Cadcon secured a number of important contracts such as work at Nampak in Rosslyn and the BMW Paint Shop in Rosslyn. The BMW project 'put them on the map' and Cadcon expanded by moving from a rental factory in Waltloo, into their own self built factory and offices in Lyttleton, Centurion.

With their growing recognition in the automotive industry they landed the new paint shop for Daimler Chrysler in East London. They then went on to do quite a few projects for the BMW (SA) plant in Rosslyn and the Daimler Chrysler plant in East London and established themselves as a reputable company.

The Mauritius Commercial Bank in Ebene, Mauritius.

The 2010 Mbombela Stadium in Nelspruit.

6.7m Diameter Ducting Supports in Cadcon's workshop facility.

Their differentiator from the start has always been their competitive pricing in conjunction with quality workmanship.

These projects formed the platform for Cadcon to grow, starting with their first factory of 2 500m² expanding into their current premises consisting of four factories with 12 235m² under roof, as well as offices and stores covering another 2 233m². They recently also acquired more land (1.5 hectares) in close proximity to their factories and offices which is utilised as a stock yard.

Cadcon's fourth workshop facility is currently being expanded to handle a R45 million ducting support and platework contract for the Medupi Power Station in Ellisras.

1997 saw the departure of Gerhard who immigrated to Australia. Barry then met Richard Butler who had worked with Cadcon on the BMW Paint Shop project as a quantity surveyor for Scoombie Hartman Quantity Surveyors at the time. Together their expertise and initiatives formed a great partnership to grow from strength to strength.

Richard's responsibilities were much more 'hands on' and included financial planning, tenders, programming, claims and the co-ordination of their projects. At that stage, Barry was responsible for production, quality control and erection.

Growing into a leading steelwork fabricator and erector locally, they decided to broaden their service base by adding a design element to their company. With this new market in mind, Johan Jonker joined Cadcon who had vast experience in structural design, planning, detailing and construction supervision as a civil engineer.

This opportunity allowed them to establish Mictec, an in-house but stand alone design engineering firm. Cadcon now offered a turn-key solution to clients from engineers design, fabrication up to final construction phase and erection of steelwork.

THEIR CAPABILITIES/ACHIEVEMENTS

- ISO9001 : 2008
- 3834 Welding Certification in Progress
- Supply, fabricate and erection of:
  - Structural steelwork (300 – 600 tons per month depending on mix of steelwork)
  - Ducting and platework (50 – 100 tons per month)
  - Architectural steelwork
  - Bridge steelwork
- In-house design department

Cadcon's factories boast the latest technology CNC machinery to provide the highest quality fabrication. The list of high quality FICEP equipment is as impressive as can be. This includes the various types of CNC machines including a combination plasma/ gas plate profiler, angle line, 22m in-feed saw and beam line machines, drilling line, all to ensure high production and quality fabrication. Also included are two Heli

Architectural Arch at Bagatelle Mall in Mauritius.

ACC-Steelwork at Medupi Power Station, Ellisras (25 000 tons in JV).

N1 Highway Bridge, Lynnwood Pretoria for SANRAL.

Sandton Redevelopment Project.

Engineering guillotines that can cut up to 20mm x 3 meter wide and their bending brakes have capabilities of up to 400-ton x 4 meter. Each factory is well planned and ensures smooth processing of all steel components until it reaches final inspection and transport to site.

To help facilitate this procedure, Cadcon has 24 overhead cranes ranging from 5 to 20 ton capacity. The company has 10 mobile cranes with a capacity ranging from 8 to 90 ton. The new stockyard will be serviced by a large tower crane to receive and load stock lengths for production.

The company also offers abrasive blasting, corrosion protection and the erection of structural steelwork. Other services offered are crane, truck and trailer hire. Part of their fleet includes 22 metre trailers able to accommodate abnormally long loads.

THE PROJECTS

The list of recently completed projects is as impressive as the growth of the company itself and includes the following projects:

- ACSA CTB Building, JHB (110 mil)
- 2010 FIFA Mbombela Stadium (50% in JV with A. Leita) (100 mil)
- 2010 FIFA Peter Mokaba Stadium (30% in JV with A.Leita/ Omni-Struct) (R100 mil)
- Electronic Toll Plazas for SANRAL (100mil)
- ABSA Towers, JHB (32 mil)

Projects in progress are:

- Eskom Medupi Power Station, ACC units, Ellisras (25 000 tons x 40% in JV with A.Leita & Boksan Projects)
- Medupi Ducting Supports (1 000 tons), Ellisras
- Medupi Sub-stations and Main Workshop (700 tons), Ellisras
- Bagatelle Arch Structure, Mauritius
- Sandton City upgrade (In JV with Tass Engineering)

THE PEOPLE

The directors of Cadcon assign their success to hands-on management and therefore they do not have an excessive office staff complement. There are 18 office staff members including the three directors (Barry Barnard, Richard Butler and Johan Jonker) and, very importantly, Hilda, who provides everyone with coffee, tea and biscuits during the day. 183 very competent workers keep the workshop running efficiently.

Adam Barnard, better known as Barry, is responsible for the fabrication and quality control at Cadcon's various factories. The 56-year young man started his career as a fitter and turner apprentice with ISCOR. While working full-time, he achieved his National Diploma of Technicians at Pretoria Technicon. Barry then studied further at the University of Pretoria and received his B.Eng (Mech) in 1986.

Johan Jonker, who joined the company in 2002 with more than 22 years experience in design and construction in a wide variety of structures in reinforced concrete and structural steelwork, varying from high rise to residential buildings. His resume is impressive and includes a B.Sc. Eng (Civil) and B.Eng. (Hons) degree. He is a member of various professional organisations including ECSA, MSAICE and SAICE. Before he joined Cadcon, he was a director at DLV Pretoria.

Richard Butler is responsible for the financial planning, tendering, programming and co-ordination of the works, as well as for the monthly claims. Richard has a B.Sc Quantity Surveying degree and was awarded the Top Student award for Quantity Surveying for five years running while studying at the University of Pretoria. As mentioned previously, he was employed by Schoombie Hartman as quantity surveyor before joining Cadcon in 1997.

While talking to these men of steel, one gets the feeling of their total commitment and pride in their company but also an inherit personal humility. No wonder they manage to supply the industry with top quality fabrication and workmanship.

IMPILO ENTSHA: NEW BUILDING PROJECT KELLOGG'S, SPRINGS

This upgrade was achieved in a cost effective manner with minimum disruption to production by opting for an unusual alternative – roof over roof construction – and at a cost of far less than constructing a new facility. Without steel this option would not be possible and without cellular beams it most certainly would be much more expensive.

Steel was the only perceivable cost effective solution. In short, without steel construction this project would not have been possible.

The existing production facility of Kellogg Company of South Africa in Springs dates back to the 1950's and has been expanded numerous times to sustain and maintain current production and new equipment requirements.

Due to Kellogg Company's continued development in Africa to satisfy the growing need for quality nutritional products, the facility needed a 'face-lift' again as available floor space in the existing facility was limited and did not provide for any further operational expansions. Thus Project Impilo Entsha was born with the aim to upgrade the facility in line with current international production facility designs and standards as well as increase the floor space to accommodate future development.

Various options were considered for upgrading the facilities, but due to financial restrictions, the bold venture was undertaken to construct a new structure that encompassed the existing facility whilst production continued, and demolish and remove the old building from within the new 'shell'. The new building's footprint is sufficiently larger to accommodate further expansion.

CHOICE OF STEEL AS STRUCTURAL COMPONENT

Steel was the only perceivable cost effective solution. In short, without steel construction this project would not have been possible. Taking all the capital costs into consideration, the useful life span of the production facility was significantly extended at approximately 60% of the cost of constructing a new facility.

The structural design is a single ridge with a monitor section at the crest. The choice of steel, and specifically cellular beams, was influenced by the following:

FACT SHEET

Overall length of building:
191.3m

Width of building (max):
67.03m

Height of building:
9m (eaves), 14.4m (apex), 17.2m (monitor)

Floor area:
11 050m^2

Maximum span of single member (cellular beam):
23.18m

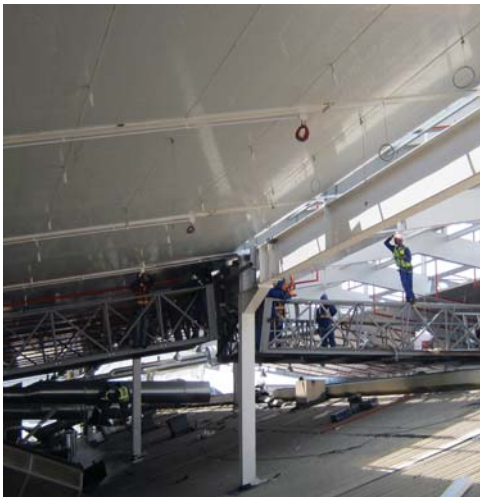
Total weight of structural steel:
770 tons

This 3D model gives a bird's eye view of the whole project.

- Food safety – exposed structural steel surfaces in the facility are deemed food safe as opposed to concrete that could support microbial growth in pores and cracks. The erection of steel columns within the factory also posed a significantly reduced food safety risk compared to the construction of concrete columns which require more labour and material for extended periods of time during construction.
- People safety – construction occurred over the facility during full production. The choice of steel allowed the isolation and barricading of small areas of the facility for limited times during mayor lifts. During this time safety personnel in radio contact with the erection crew outside would regulate the people movement inside the factory. Disturbance to people and equipment was limited as column positions were pre-determined with the input of the facility personnel and did not require formwork and scaffolding which might have limited movement and posed a safety risk while in place.
- Brownfield construction in an existing facility – limited positions for the positioning of internal support columns were available as a result of existing equipment layout and personnel and equipment movement routes. The choice off cellular beams allowed for long unsupported spans, thus reducing the need for columns.

SPECIAL CONSIDERATIONS

All electrical services, process and fresh air ducting as well as the sprinkler reticulation and ceiling had to be installed in the space between the old and new roof structure. To accomplish this, movable platforms were designed to be supported from the new roof structure to provide access for the installation of the ceiling and services. The construction loading due to the access platform



Columns were installed through small local openings in the existing roof and then waterproofed to ensure no external contamination of the sterile environment below.

was a significant factor to take into account for the design of the structural roof members.

As a result of the long unsupported spans required and the construction loads, normal hot rolled I-beam sections were not an option and cellular beams proved to be a cost effective alternative to the use of plate girders.

The following cellular beams were utilised:

796.1 x 210 CB c/f 533 x 210 x 82 UB

804.5 x 210 CB c/f 533 x 210 x 101 UB

807.3 x 210 CB c/f 533 x 210 x 109 UB

Plate girders (820 x 250(8w,20F) – 143 kg/m) were used between the internal columns and provided intermediate support to cellular beam rafters, as commercially available hot rolled I-beam sections or cellular beams were not an option due to the limited number of internal columns, long spans and loadings from the rafters.

project team

Developer/Owner:

Kellogg Company of South Africa (Pty) Ltd.

Dion Metcalfe (Engineering Director Asia Pacific)

Structural Engineer:

Greene Consulting Engineers (Pty) Ltd.

Quantity Surveyor:

Greene Consulting Engineers (Pty) Ltd.

Project Manager:

Greene Consulting Engineers (Pty) Ltd.

Main Contractor:

JJF Construction cc.

Steelwork Contractor:

Imbriolo Engineering Works (Pty) Ltd.

Detailers/Detailing Company:

A. Leita Steel Construction (Pty) Ltd.

Cellular beam supplier:

Macsteel Trading (Pty) Ltd.

Food Facility Engineer:

Viko Consulting Engineers

Cellular beams proved to be a cost effective alternative to the use of plate girders.

A tower crane on rails with a reach to cover both the north and south façades had to be utilised to ensure uninterrupted lifting and installation of columns and rafters.

Columns were installed through small local openings in the existing roof and then waterproofed to ensure no external contamination of the sterile environment below.

The long cellular beam sections of up to 23 meters in length as well as the apex rafters required delivery to be done as abnormal loads. These had to be planned carefully, taking into account the restrictions during holidays and were unfortunately influenced by the truck driver strike during early 2011.

CONCLUSION

The choice of steel as construction material resulted in a product being delivered to the client that satisfied their original need for a world-class production facility with additional capacity for future expansion.

This was achieved in a cost effective manner with minimum disruption to production by opting for an unusual alternative – roof over roof construction – and at a cost of far less than constructing a new facility. Without steel this option would not be possible and without cellular beams it most certainly would be much more expensive.

The choice of steel allowed the isolation and barricading of small areas of the facility.

TOWER FOR MASCOM WIRELESS BOTSWANA INNOVATION CENTRE

The concept of a tri-legged aesthetically shaped tower with external working platforms was therefore an attractive alternative, especially as the elegant lines and symbolism of the proposed structure resonates with the architecture of the buildings.

The tower's multi levels are accessible by means of a ladder-way.

Mascom Wireless, the leading cellular telephone service provider in Botswana, is in the process of constructing a new Innovation Centre in Gaborone, Botswana. To handle the significant flow of data and voice traffic into and out of the Innovation Centre, a tall tower, which has 3600 azimuth (an angular measurement in a spherical coordinate system) and multi-level microwave antenna mounting capacity, is required for the current and future requirements of the Mascom Wireless cellular telephone network.

Due to the close proximity of the Innovation Centre to Gaborone International Airport, Mascom Wireless recognised an opportunity to commission the design of a tower to compliment the new Innovation Centre which would simultaneously satisfy all of the technical requirements that are commonly associated with heavy duty lattice tower structures.

The appointed team conceived an elegant design for a 55m tall tri-legged monopole tower to meet the requirements for an iconic, yet functional structure. The design has the appearance of three elephant tusks standing on end. The functionality of four circular antenna mounting platform levels, built within the tri-legged

The Mascom 'Cool Tower' structure is now a landmark in Gaborone.

The placement of the four external working platforms, within very tight tolerances, presented an unusual challenge to the rigging team.

The individual legs taper individually and as a group to a point of contra-flexure where the working platforms are accessed.

tower, provides for all-round visibility on multi-levels which are accessible by means of a ladder-way. All the feeder cables are routed into and are concealed within the tubular legs of the tower, which also provides personnel access from ground level to the platforms.

The Mascom 'Cool Tower' structure is now a landmark in the otherwise urban sprawl of Gaborone and is a prominent advertisement of innovative design and construction using structural steel.

WHY STEEL WAS CHOSEN FOR MASCOM'S TOWER

There are many examples of reinforced concrete telecommunications towers but generally such structures are only economically viable for towers less than 60m tall. These are usually for military installations where a high level of security is essential, or, for taller towers such as the national primary infrastructure for television, radio and telephone communications.

For the Mascom Innovation Centre, the choice was between the traditional structural steel lattice tower, monopole or guyed mast structure. The tower had to have sufficient face area to deploy all planned antennas within height restrictions acceptable to the Civil Aviation Authority. Such structures are normally fabricated from tubular of angle structural steel sections or rolled plate. These traditional structures did not suit the customer not only due to space and height restrictions because of the close proximity to the airport but they also did not complement the architecture of the new Innovation Centre.

Several monopole structures would have been required to provide sufficient space with accessible working platforms to accommodate the required communications antennas, feeder cables and hardware. The concept of a tri-legged aesthetically shaped tower with external working platforms was therefore an attractive alternative, especially as the elegant lines and symbolism of the proposed structure resonates with the architecture of the buildings.

project team

Developer/Owner:

Mascom Wireless – Botswana

Structural Engineers:

Ritchie Midgley
Sectional Poles

Quantity Surveyor:

In-house Brolaz South Africa (Pty) Ltd

Project Manager:

In-house Brolaz South Africa (Pty) Ltd /
Brolaz Botswana

Main Contractor:

Brolaz South Africa (Pty) Ltd /
Brolaz Botswana (Pty) Ltd

Steelwork Contractor:

Sectional Poles (A Division of Harrison and White Investments (Pty) Ltd)

Detailers/Detailing Company:

Sectional Poles (A Division of Harrison and White Investments (Pty) Ltd)

Rolled galvanized Grade 355 steel plate was selected for the body of the tower because of the tried and tested methods of seam welding the plates into tapered cones which are then spliced into segments with slip-fitted joints. Internal steel bolted flanges locate the tower segments within the tolerances required for the tapered and curved form and also achieves the precision required for locating the platforms. The resultant form is elegantly slim and aero-dynamically efficient whilst the circular cross-section is structurally efficient. Platforms and associated components were fabricated in tubular and hot-rolled galvanized sections.

WHAT IS UNIQUE ABOUT THE STEELWORK

The basic structural components of this tri-legged tower structure are universally used throughout the cellular telecommunications industry for conventional monopole construction. The unusual and aesthetic application of these basic building blocks is what is special about this structure.

The form of the structures is elegant yet functional – providing a large footprint at the base for stability. The individual legs taper individually and as a group to a point of contra-flexure where the working platforms are accessed from the internally climbable legs. The four platforms anchor the separate monopoles so as to reduce wind generated deflection, thereby providing a steady mounting for the sensitive electronic equipment. The four platform levels are integrated by means of a centralised external access ladder which provides safe use by technical staff. The aircraft navigation warning lights are also readily accessible from the topmost platform for routine service and maintenance, an essential requirement given the proximity of the tower to Gaborone International Airport.

SPECIAL CONSIDERATIONS IN THE DESIGN PROCESS, FABRICATION, TRANSPORT AND ERECTION

The design of the structure was undertaken using several analytical models. Each leg of the tower was analysed as an independent structure with proportional total wind and platform loads. The composite structure with platforms linking the poles was in turn analysed to constrain the deflections to the permissible limits of the articulated pin joint connections between the platforms and the three monopoles.

Various software programmes were used, including Robot, Guymaster and Sectional Poles in-house software, as well as hand analysis.

The individual curved monopole leg elements are constructed of several straight lengths of slip-fitted tapered tubular elements which are bolted together with internal flanges which are offset so as to create the curved shape. Alignment of the straight lengths to prevent twist (like a Kudu horn) was essential, with precision repeated on all three legs so that the completed poles are of equal length, and when erected, the 3-dimensional level and alignment of the platform connecting pins are accurately positioned at three tangent points at heights of 35m, 40m, 45m and 50m respectively.

Erection of tall monopole structures is routine throughout the cellular telecommunications industry. In this case the proximity of the new Innovation Centre and adjacent legs of the tower as well as placement of the four external working platforms, within very tight tolerances, presented an unusual challenge to the rigging team, lead by a 35-year veteran telecommunications tower rigger.

THE STATS OF THE TOWER

Overall height of structure:	55m (plus 2m lightning spikes)
Mass of steel in superstructure:	49 000kg
Cranage:	100 ton mobile crane
Total duration for superstructure:	2 weeks assembly and erection
Area of steel plate in tower legs:	500m^2
Diameter of tower legs:	Base – 1 326mm, Top – 450mm
Platform levels:	35m, 40m, 45m, 50m
HD Bolts at base of tower leg:	32 x 42mm diameter high tension bolts

CHALLENGES AND SOLUTIONS

Co-ordination of levels and orientation of the civil works were the key challenges to provide an accurate base from which the three legs were launched. This was facilitated by fabrication of a template spanning over the whole footprint of the foundation which was used to level and align the 96 number M42 Anchor Bolts.

Accurate rolling, jigging and welding of the various tapered and slip-fitted leg elements and pre-assembly of the internal flanged joints was the solution to creating the smooth curved pole from straight segments. Precision fabrication by Sectional Poles was required to align all 1 038 connection and splice bolts used in assembly of the structure. The 49 ton superstructure was rigged in five days with a total of two weeks on site required for component assembly and erection.

The 49 ton superstructure was rigged in five days.

MCB EBENE FOR MAURITIUS COMMERCIAL BANK

This unique looking building was of course not without its design and construction challenges. This was the first time a sustainability concept based on the principles of BREEAM (BREEAM is the world's foremost environmental assessment method and rating system for buildings) was implemented in Mauritius.

The elliptical shape of the building is achieved by the use of curved precast concrete columns and curved structural steel members from level seven upward.

PROJECT DESCRIPTION

Ebene is 15km south of the capital of Mauritius, Port Louis. The city is being promoted as a new information technology hub for Mauritius and as a link between African and Asian markets and is referred to as Ebene Cyber City. Thus the elliptical shaped nine-storey building for the Mauritius Commercial Bank epitomises the city's high tech image and is certainly set to be a landmark in Ebene.

This unique looking building was of course not without its design and construction challenges. This was the first time a sustainability concept based on the principles of BREEAM (BREEAM is the world's foremost environmental assessment method and rating system for buildings) was implemented in Mauritius.

The building is designed to accommodate 750 staff members and contains two auditoriums seating 275 and 20 respectively. The fourth floor is dedicated to the training department of the bank, holding a 100 seat conference room for trainees and staff. The building can accommodate 1 100 people at full capacity. It rests within a 6 acre manicured landscaped garden. The site contains 263 parking bays as well as additional space for coaches and bicycles.

THE STRUCTURE

The lower portion of the structure consists four 'legs' formed by the external walls, cross walls, lift walls, staircase walls, rectangular and L-shaped reinforced concrete columns, which all work together to resist the vertical and lateral loads on the structure. These 'legs' are supporting the elliptical skin of

The roof steelwork consists of curved asymmetric cellular beams with three different radii.

the building which supports six flat slabs and the bottom auditorium slab. The elliptical shape is achieved by the use of curved precast concrete columns from level four to level seven. Curved structural steel members are used from level seven upward.

To enable a column free space in the main auditorium, the frame includes transfer structures between levels four and five. Similarly, the building entrances are kept column free by means of steeply raking columns supporting one of the transfer structures. Bracing and core walls, supplemented by large diameter columns, provide lateral stability. The ellipse cladding consist composite aluminium panels and glass rings to allow natural light into the building. A full height double glazed curtain wall system forms the northern and southern façades of the building. Steelwork was also used to achieve the curved look on the sides of the legs below the ellipse. Travertine stone was applied as cladding for this area.

THE STEELWORK AND THE DESIGN PROCESS

The main steelwork in the building includes the roof steelwork, the steelwork supporting the travertine cladding at the legs, the lift steelwork, the dog-legged staircases at the eighth floor, and the canteen steelwork.

The roof steelwork consists of curved asymmetric cellular beams with three different radii. These were supported at the seventh floor slab and on transverse steel beams that span between circular reinforced concrete columns. The roof is exposed to cyclone conditions, with wind speeds of up to 275km/h. The curved beams also support 150mm deep precast panels. Deflection of the beams at the edges had to be limited to 10mm over a 9m span because of the height of the glass façades on the northern and southern side. Wind uplift forces are the most extreme at the ends due to localised pressure.

The smallest radius on the beams was 16m, which was a challenge from a curving perspective. Cellular beams made it possible to achieve the required radii, the upper section of the beam was from a 305UC and the lower section was from a 533UB. This provided the required stability to limit the deflection without compromising on the limited ceiling space. The increased flange width of the upper section due to the use of the 305UC, made it easier to connect the precast concrete panels to the steel. Care was taken in the detailing of the connections to provide the required tolerances to allow for accurate construction of this roof.

Curved 152UC were used to support the Travertine cladding at the legs of the building. These columns were also supporting stainless steel grills at the plant areas. Innovative connection details were designed to support the stone cladding and the tip-up grill doors leading to the plan rooms in the legs.

The lifts are constructed of steel and glass and exposed circular hollow sections were used for its aesthetic appeal and to support the lift equipment including the counter weight brackets, car guide rails and lift doors.

FABRICATION AND TRANSPORTATION

To insure that the cellular rafters were fabricated within the maximum tolerances and that the correct radii were achieved the rafters were pre-assembled on the workshop floor and fabricated in nine sections using three different radii.

project team

Developer/Owner:
The Mauritius Commercial Bank Ltd

Architect:
Jean Francois Koenig Architects

Structural Engineer:
Arup (Pty) Ltd and ArupSIGMA Ltd

Facade Engineer:
Arup (Pty) Ltd

MEP Engineer:
Arup Group Ltd and Proburo Ltd

Quantity Surveyor:
Hooloomann and Associates Ltd

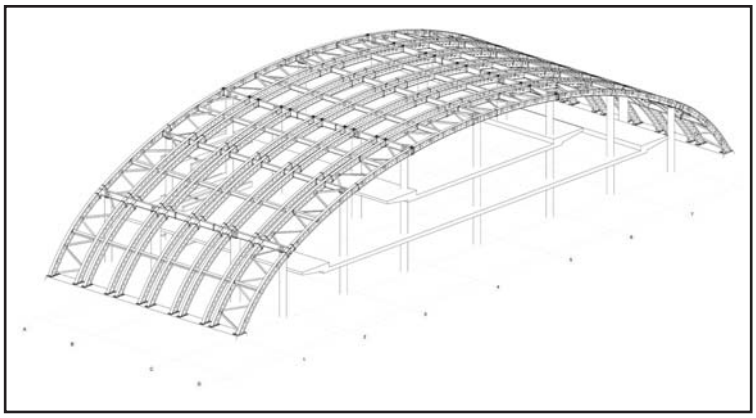
Project Manager:
ArupSIGMA Ltd

Main Contractor:
General Construction Company Ltd

Steelwork Contractor:
Cadcon (Pty) Ltd

Facade Contractor:
Geustyn & Horak (Pty) Ltd

Detailers/Detailing Company:
Mondo Cane Detailing and Design Services



Care was taken in the detailing of the connections to provide the required tolerances to allow for accurate construction of this roof.

The hot dip galvanized fabricated steel sections were loaded into 40" open top containers at Cadcon's premises, transported via road to Durban harbour and then shipped to Port Louis. Shipment including clearance took between five and seven days.

The steelwork fabricator successfully overcame the logistical challenge to manage fabrication and shipment in the sequence to follow the order of construction on site therefore maintaining the construction according to plan and keeping the client happy.

CORROSION PROTECTION AND ERECTION

Once the containers were received and off loaded on site the steelwork had to be degreased, washed down and painted with two coats of Corrocoat primer and two coats of Polyurethane water based top coats before been lifted into position. Adverse weather conditions made the painting process difficult and keeping to the project programme a real challenge.

Another logistical challenge was to ensure that all the necessary rigging tools, equipment, consumables and fixing anchors where identified and shipped independently in Cadcon's own container which was to be received on site before the erection started and set up as a site store. Anything not identified or accounted for would have had to be flown in at a premium cost and this was luckily avoided due to good planning on the contractor's side.

The Mauritius Commercial Bank epitomises the city's high tech image and is certainly set to be a landmark in Ebene.

HOUSE KAHLER

In the previous issue of Steel Construction we featured the upmarket House Raubenheimer situated on a game farm near Bela Bela that used light steel frame building to its full advantage. In this issue we feature another luxury residential project illustrating that LSFB is suited for any building application and that more and more home owners are looking at this alternative building method to build their dream house.

The light steel frame structure of the house.

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House Kahler is built on a game estate on the outskirts of Pietermaritzburg, KwaZulu-Natal. It is a 510m^2 light steel frame building that has four bedrooms, a study, three bathrooms, lounge, kitchen, a dining room, T.V. lounge, servants' quarters and a triple garage. *(In other words not your average 'central locking' complex unit. Ed)*

The structure of the house is a light weight steel frame system (wall panels, roof trusses and roof panels) with colour bond corrugated iron roof sheeting. The wall cladding comprises fibre cement flat sheet, OSB board, 102mm cavity batt insulation and 15mm Gypsum board.

An evening view of showing the internal space of the house opening onto the veranda.

project team

Developer/Owner:
Bjorn Kahler

Architect:
Virtual Architects

Structural Engineer:
Design Desk

Project Manager:
Shospec (Pty) Ltd

Main Contractor:
Shospec (Pty) Ltd

Steelwork Contractor:
Shospec (Pty) Ltd

Detailers/Detailing Company:
Steeltek Systems (Pty) Ltd – LSF Roller

The client was entrhalled with the excellent quality finish of the house.

LSF was chosen due to its energy efficiency, speed of construction and quality finish. The choice of using this building method was based on the Shospec's (main contractor, project manager and steelwork contractor of the project) experience in using alternative building methods, their sound research and development in LSF, as well as having existing projects that proved LSFB an excellent building method.

DESIGN

The house was designed to comply with the architectural guidelines of the estate which is based around a 'country/farm lifestyle' with large verandas and a light vernacular.

The interior is modern and minimalistic with clean lines and large open plan areas. The home opens up into one free flowing area by opening nine 2.4m-high stacking glass doors which all lead onto the veranda.

Using LSFB also enabled the contractor to accomplish the slick, slim lines and excellent quality finish of the house, which are not easily achieved with conventional building methods.

The LSF structure, external cladding, windows and roofing took nine weeks to complete.

CONSTRUCTION TIME LINE

The concrete raft foundation of 510m^2 was laid in mid May 2010 and completed by the end of May 2010. Steel erection commenced on 3 June 2010 and the house was occupied by 22 October 2010.

- The entire super structure was complete and ready for occupation in 21 weeks.
- The LSF structure, external cladding, windows and roofing took nine weeks to complete.
- The high quality features and finishes internally, including the installation of nine folding stacking glass doors, were completed in the remaining 12 weeks.

ENVIRONMENTAL SUSTAINABILITY AND ENERGY EFFICIENCY

The home was designed with numerous features to conserve energy and water as well as considering possible expansion.

During construction there was minimal material waste and transport requirements were considerably less than in a conventional building. The home has solar water heating, a 500L grey-water system that irrigates the garden automatically twice a day and a 15 000L rainwater storage tank with distribution options to either service the garden, laundry or the whole house if need be. Ten sky lights, seven top lights above the veranda roof and solar efficient glass on the east and the west sides of the home maximise natural lighting and ventilation. LP gas was installed for heating and cooking.

The roof sheeting was fitted with 50mm insulation under the sheeting as well as 100mm Aerolite insulation above the ceiling to achieve maximum thermal insulation. All doors have sealed thresh holds to minimise drafts.

THE VERDICT

The owner, Bjorn Kahler is once again convinced that LSFB is the way to go: "The quality of finish achievable with LSF is excellent. We have had no regrets in choosing an alternative building method compared to conventional methods. Furthermore we experienced no problems with our bond application, NHBRC or local authorities in accepting a LSF building method."

For more info visit www.shospec.co.za or contact Tel: 033 386 0100/033 386 0103 Fax: 033 386 0104.

SASFA CARRIES OUT AN INDUSTRY SURVEY

By John Barnard, SASFA director

Incidentally, in another survey carried out amongst owners or tenants of LSF houses, the response indicated that most felt that LSF houses are cooler in summer, warmer in winter, and have acoustic properties that are the same or better than masonry buildings.

SASFA carried out an industry survey recently in order to obtain strategic guidance from industry regarding its future industry development action plan. The respondents – mainly SASFA member companies – were required to complete progressive questions to indicate areas or topics they believed required attention.

Feedback indicated that the market felt that training, accreditation of members and marketing should be the major focus areas for SASFA.

The 6-day course for light steel frame building contractors is deemed to be the most important training programme. It is regularly presented in major centres in South Africa. The one-day training course for designers will be repeated early next year.

The survey also showed that lack of awareness of the advantages of LSF amongst engineers and architects, developers and future home owners is seen as one of the obstacles to expand the market. Accordingly, SASFA should focus its promotional activities on this group.

In order to reach the various professions in the building industry, SASFA will be exhibiting at the Green Building conferences and exhibitions in Johannesburg and Cape Town, as well as at the Master Builders' annual conference. Workshop sessions are being arranged with the regional institutes for architects, in collaboration with the SAISC. Furthermore, SASFA's publicity campaign will include publishing project articles in identified publications to inform the broader public of the growth and development of light steel frame building.

Incidentally, in another survey carried out amongst owners or tenants of LSF houses, the response indicated that most felt that LSF houses are cooler in summer, warmer in winter, and have acoustic properties that are the same or better than masonry buildings.

One owner explained that it was much quicker to heat or cool the interior of a LSF house with its well insulated walls, as one did not have to heat or cool tons and tons of masonry in order to change the internal temperature in the house.

In summertime, the LSF walls do not absorb heat during the day and so the house cools down quickly when external temperatures drop, unlike the case with heavy masonry walls. In wintertime the good insulation of LSF buildings, and the low mass of the walls, makes it easier to heat up the interior.

Zambesi Mall – Light Steel Frame Award winner, Steel Awards 2010.

SOUTHERN AFRICAN
LIGHT STEEL FRAME BUILDING ASSOCIATION

SOCIAL SNIPPETS

By Marlé Lötter,
Events Manager, SAISC

SAISC BREAKFAST TALK, 1 JUNE 2011, COUNTRY CLUB JOHANNESBURG – A DOUBLE-TAKE!

The scheduled guest presentation by Andrew Etzinger, senior general mananger responsible for Eskom's integrated demand management programme, was well attended by around 75 guests. Andrew presented an informative overview of the electricity system status, municipal supply considerations and energy loss management, also looking into the initiatives for own and co-generation of power.

Two fascinating snippets from Andrew's presentation:

- Marijuana (or 'dagga' in our local vernacular) is considered to be the top cash crop of the USA with indoor pot-growing operations consuming around 22bn KWh/year, roughly 1% of the national consumption.
- Eskom do planned maintenance in summer, when demand is lower to ensure maximum capacity in winter. So, no load shedding is scheduled for the winter months. (However, that cannot prevent unforeseen power failures due to cables that are stolen or damaged in construction work, for example.)

Visit www.49m.co.za for information on Eskom's initiative to help the nation embrace an energy saving culture.

Guests to this SAISC breakfast talk also had the special opportunity of listening to a short presentation by Thierry Braine-Bonnaire, construction portfolio leader for ArcelorMittal, who was on a visit from France. He gave a brief report of global product research and development lead by ArcelorMittal. Visit www.constructalia.com for the product catalogue, brochures, software and case studies.

For an electronic copy of the presentations of Andrew Etzinger and/or Thierry Braine-Bonnaire send an email to marle@saisc.co.za

IPS 2011

Spencer took a group of steelwork contractor members on a three-day visit to the IPS 2011 at Kaltenbach's factory in Lörrach (Southern Germany). What an experience that was: State-of-the-art machinery and software to keep an engineering boy who loves high-tech engineering machines and the like in awe.

Kaltenbach had on display saw cutting (the fastest saw in the world), drilling, plate processing, shot blasting and painting equipment. Their partners had straightening, pre-

Delegates having some fun at IPS 2011.

Andrew Etzinger presenting a status report of the ESKOM power system.

Thierry Braine-Bonnaire of ArcelorMittal reporting on global product research and development.

cambering, plate girder assembly and welding, the flowdrill range of products, material stacking for service/merchants and lots more. Most of it highly advanced NC driven.

The highlight was surely the walk through the Kaltenbach factory (you can eat your breakfast off the floors) and how they use their equipment in a production environment including the integration of robotics into their systems.

See page 14 for the whole story.

THE JUDGES

The Steel Awards adjudication has come and gone and preparation for the 'big event' is in full swing. The judging process is somewhat taken for granted by most guests at the party when viewing the presentation of the winners. What they don't know is that most of the time the judges have to be at the meeting point at 06:30 in the morning and that their day often ends after dark. They land in Durban in the morning, visit all the sites and fly to Cape Town the same evening to repeat the process. Lunch is often taken on the run. These guys must really love steel! The one thing that keeps them going is their sense of humour and never taking themselves too seriously.

Thanks John, Hugh, Steve, Johann, Franco, Peter, Spencer and Neil!

All together now!

Looking up.

THE STEEL CONSTRUCTION AWARD FOR EXCELLENCE IN THE USE OF STRUCTURAL STEEL

SAISC STEEL AWARDS 2011

The 30th Event

Date: 15 September 2011

Venue: Johannesburg – Emperors Palace, Kempton Park
Durban – Sun Coast Casino, Durban
Cape Town – The Ball Room, One&Only Hotel, Dock Road, Victoria & Alfred Waterfront

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2 The Treehouse
3 Phuthaditjhaba Stable Block for SAPS
4 House Raubenheimer, Bela Bela
5 Renexcon
6 Laerskool Pretoria-Oos Tennis Clubhouse
7 House Kahler
8 Levy Business Park, Lusaka, Zambia
9 Monsanto
10 Tower for Mascom Wireless Botswana Innovation Centre
11 Novo Packhouse
12 VST for the 2010 FIFA World Cup
13 Comair Simulator Building
14 2010 International Broadcast Centre
15 Eureka DIY Solutions
16 Dorstfontein Overland Conveyor River Crossing
17 Mangaung Intermodal Bridge, Hangar Street
18 Buitengragt Pedestrian Bridge
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20 Zwelitsha Pedestrian Bridge
21 Mall of the North
22 New Headgear for Goldfields Southdeep Twinshafts Vent Shaft
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31 Waterkant Pedestrian Bridge
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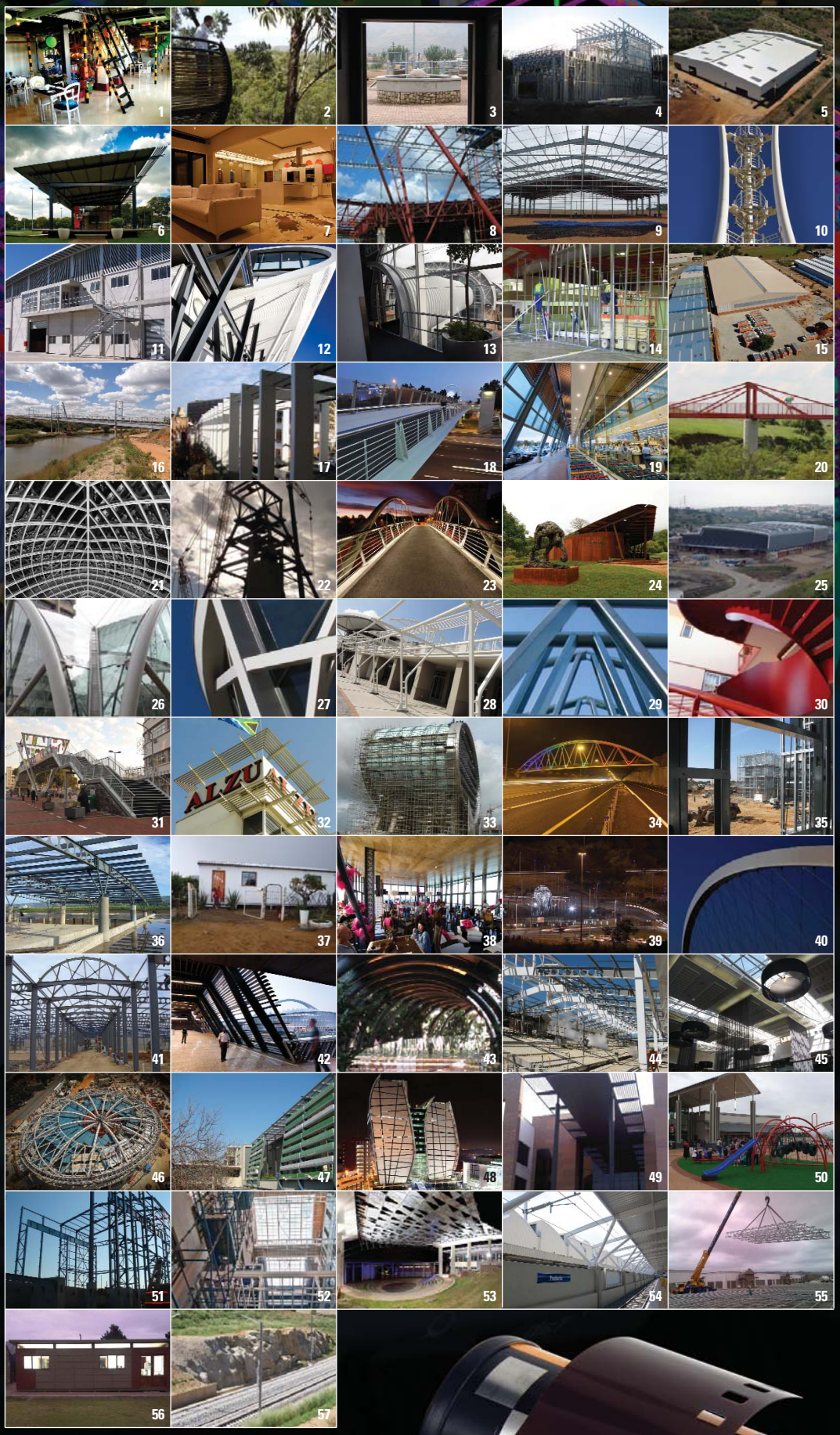
33 MCB Ebene for Mauritius Commercial Bank
34 Lynwood Glen Pedestrian and Pipe Bridge
35 2011 All Africa Games – Athletes Village
36 Facilities at Kisumu Airport
37 Parys Project
38 Moyo on the Pier
39 Fountains Circle
40 Crystal Towers Bridge
41 Strandfoam Kosmosdal
42 Moses Mabhida Station
43 Saxon Hotel, Skywalk Bridge
44 Impilo Entsha: New Building Project Kelloggs, Springs
45 Upper East Side
46 Sandton Protea Court
47 Engineering III Building and Parkade at the University of Pretoria
48 Alice Lane
49 Walker Creek Entrance Canopies
50 Brits Mall
51 South Deep Mine Rock Winder House
52 Pretoria Government Building Rehabilitation
53 Lebone College II
54 Gautrain – Pretoria Station
55 KwaNobuhle Shopping Centre
56 Glenwood House Private School
57 Gautrain High Speed Rail



STEEL AWARDS PHOTO COMPETITION ENTRIES

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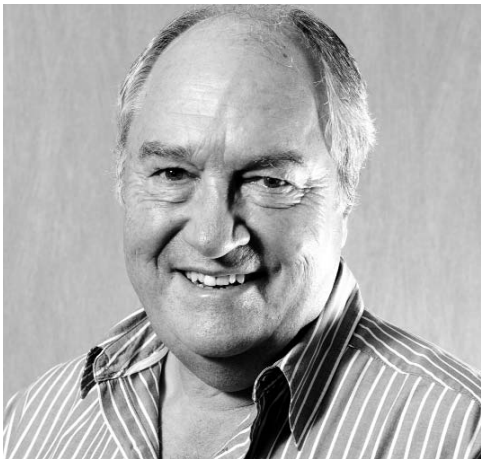


STRUCTURAL STEELWORK MULTIPLIER: A JOB CREATOR

By Kobus de Beer,
Industry Development Executive, SAISC

Assume that somebody wants to develop a new mine for which 3 500 tons of structural steelwork is required, at a cost of some R100 million, inclusive of VAT. If the steelwork is made locally, from locally-produced raw steel, the project creates 538 jobs, leads to R143 million in economic activity, and yields R36 million for the government. Besides that we retain skills and capabilities and reliable suppliers of quality products, right on the doorstep of our various industries.

Surely, if we want to combat poverty by providing jobs for as many South Africans as possible, the 'low hanging fruit' is right in front of our eyes: retain and develop the industries we already have. Force them to improve and to become globally competitive, help them to become export-oriented, but protect them and don't allow them to be killed by so-called international competition. Producing things at home rather than importing is vastly more beneficial to a country than most people appreciate.

Let me use as an illustration the industry I know – steel construction. This is the industry that buys steel plates and profiles produced by companies such as ArcelorMittal SA and then proceeds to cut this into smaller elements, drill holes, bend and shape, and weld pieces together. The resulting trusses, columns, beams, etc. are transported to construction sites where they are bolted together to become the skeletons of buildings, power stations, industrial plant, towers, bridges and a variety of other constructions.

The steel construction industry in our country is a thing we can be proud of. Cause the products of this industry to evaporate and every power station, power line, industrial building, petrochemical plant and mine will instantaneously drop into a pile of rubble. Furthermore, many large projects throughout Africa and other parts of the world have been handled by companies in this industry. On average about 40 truckloads of fabricated structural steel leave our borders every day.

Leaving aside the knowledge-intensive aspects of the industry – design, detailing, project management and handling vast amounts of information – we don't do rocket science. Welders, boiler makers, riggers, machine operators etc. don't walk around with fancy degree certificates. But they surely have decent, well-paid jobs and artisan skills that are direly needed in a developing country such as ours. They can be proud of their contribution to the economy and they can stand tall in society. The steel construction industry directly and indirectly provides employment for about 110 000 people. And the beauty is that only about R150 000 of additional capital investment is required for each additional job created, in comparison with the R0.5 million the IDC uses as a benchmark.

So here is an industry that has strategic value, exports, and creates jobs – decent ones. And yet this industry has often faced cases where steelwork was imported for construction projects, even for projects of state owned enterprises, at prices so low as to defy understanding.

In trying to understand the dynamics of this problem the Institute did two things. Firstly, we went to the countries where steelwork is procured from at discount rates,

Keep projects local and put money in South Africans' pockets.

THE INDUSTRY HAS SALES OF R20 BILLION PER ANNUM FOR EACH R1 BILLION OF STEEL PROJECTS:

SUPPLIED AND ERECTED LOCALLY

Causes R1.43 billion of economic activity:

- 50% (R715 million) for manufacturing
- 20% (R286 million) for financial services
- 10% (R143 million) for community, social
- 7% (R100 million) for wholesale and retail
- 4% (R60 million) for transport and storage
- 9% (R126 million) for all other sectors

And

- Results in R390 million of taxes being collected
- For investments in infrastructure
- For incentives for investment and export
- For social and other grants
- For services

VS

SUPPLIED AND ERECTED BY OVERSEAS CONTRACTORS

- Requires R1bn cash outflow to the supplier
- Loses 25% of potential taxes (14% VAT earned)
- Loses R1.43 billion of economic activity
- Loses 5 500 decent jobs for a year
- Loses R312m of potential capital formation
- Does not make economic sense!

to study their industries and their price make-up. It was clear that none of them had any advantage over us in terms of doing things better or being more productive. The prices of their raw product were not dissimilar to ours. The only advantages they had came in the shape of some sort of government support we had difficulty to fathom, and the way they exploit their workers: in some countries they get almost 30% more man-hours per year from a worker, at roughly the same cost.

The other thing we did was to appoint Conningarth Economists to do a multiplier study for the industry.

Let's explain their findings by means of an example.

Assume that somebody wants to develop a new mine for which 3 500 tons of structural steelwork is required, at a cost of some R100 million, inclusive of VAT. If the steelwork is made locally, from locally-produced raw steel, the following will apply:

- Some 208 man-years of employment will be created directly on the fabrication of the steelwork.
- An additional 330 jobs will be created indirectly – in the various parts of the steel industry, the mining companies supplying the ore and minerals, those who do painting and transport of steelwork, etc., but also in the remainder of the economy. Consider that all those who are employed and receive remuneration go out and spend their money on food, clothing, housing, school fees and a myriad other things. Each of these transactions sets off a train of economic activity, with people buying from others and each adding value until you get to the farmer or some other originator of a product or service.
- All these actions and transactions cause additional activity amounting to some R43 million in the economy, yielding a total economic impact of R143 million.
- All of those who are involved in the waves of economic activity originating from the fact that the steelwork is made and paid for in South Africa and who earn a salary or make a profit, pay income or company tax, and there are levies and ultimately VAT. The government ends up getting about R36 million in various taxes and levies out of the whole thing and, whatever government does with that money, it ends up being spent in the economy again.

So the project creates 538 jobs, leads to R143 million in economic activity, and yields R36 million for the government. Besides that we retain skills and capabilities and reliable suppliers of quality products, right on the doorstep of our various industries.

On the other hand, if the steelwork was imported, also at a price of R100 million, the government would get R14 million in VAT and that would be the sum total of what the country would gain from the process of creating the product. R86 million leaves the country to go and stimulate the other country's economy.

Countries such as China, India and Brazil have realised from the outset that even if it costs them as much as 30% of turnover to protect their own manufacturers the country still gains. So, despite having signed all those international treaties, they have found clever ways of protecting and assisting their industries. Proving any wrongdoing on the part of any of them is extremely difficult, as one tends to wander into a maze of the unknown and the obscure when you try, like we did, to gain a deeper understanding of things like ownership, costs, and how the money flows within a particular country. Certainly, the highly competitive cost of the steelwork exported from those countries cannot be ascribed to cheaper labour only, and definitely to cheaper raw steel that we can buy from them.

In comparison to those industries we feel highly exposed. Our situation is entirely transparent and we enjoy limited protection and no subsidies. Our government is truly committed to the governing trade treaties, in letter and spirit. They are clearly not enthusiastic about protective measures like import levies, even where our trading partners have levies on the same product. Subsidies such as those our competitors enjoy are beyond anybody's frame of reference.

It is time for us to appreciate that we cannot afford to lose our industries, especially those that are not high tech but provide employment for typical South Africans, the products of our educational system. It is time for us to appreciate that the world is moving in the direction of more protectionism, as free trade and globalism has not proved to be all they were cracked up to be, especially from the vantage point of the bulk of the population.

STRUCTURAL BOLTING ISSUES IN SOUTH AFRICA

PART 2

By Spencer Erling,
Education Director, SAISC

The first part of this article appeared in Steel Construction Issue No. 3 and described in general terms what the impact of using the newest EN codes for bolt grades and types has and is having on bolts and bolting in South Africa when compared to current/ previous South African practice. The second part is very technical and goes into a fair amount of the detail of the new specifications and should be read only by those who need to have a reasonably good technical understanding of the issues.

The first part of this article appeared in Steel Construction Issue No. 3 and described in general terms what the impact of using the newest EN codes for bolt grades and types has and is having on bolts and bolting in South Africa when compared to current/ previous South African practice. The second part is very technical and goes into a fair amount of the detail of the new specifications and should be read only by those who need to have a reasonably good technical understanding of the issues.

ISO EN 898-1: SCOPE AND THE REQUIREMENTS

- Table 2 defines the steels and chemical compositions of the bolts classes and tempering temperature.
- Table 3 defines the mechanical and physical properties required for the higher classes i.e. 8.8, 10.9 and 12.9 i.e. what we would use for structural steel connections.
- Tensile strength (Table 4 gives actual minimum failure load by diameter and class grade)
- Stress at 0.2% non-proportional elongation (defined yield strength)
- Stress under proof load (defined in tables 5 and 7) and the ratio to tensile strength
- Percentage elongation
- That the head shall be 'sound' i.e. no fracture acceptable
- Minimum and maximum 'core' hardness expressed in either Vickers hardness, or Brinell hardness or Rockwell.
- Surface hardness which is allowed to be 30 Vickers units above core hardness (maximum) and very clearly defines the maximum hardness permitted for the various classes. There are various other bits of information in the table relating to carburizing and de-carburizing of the threads. This means the migration of carbon to or from the thread surface during heat treatment and where and how to test for this phenomena. *(More detail to follow in a later article).*
- Impact strength (Charpy notch test) to be done at -20°C and have a minimum value of 27 joules.
- Tables 4, 5, 6 & 7 specify the actual loads required for ultimate and proof loads by diameter and by coarse or fine thread. (By calling up a load, the calculation of the effective diameter has been done elsewhere.)
- Clause 8 covers the "Applicability of test methods". Some tests will be done on a finished bolt; others will be done on a machined coupon from a bolt.
- The fact that non-standard heads of bolts means that the failure is not likely to occur in the thread but in the head itself is taken account of in the specifications. (typically countersunk or round head bolts refer).
- Table 8 covers 'complete bolt' tests, by diameter and class. It applies to structural size bolts and shows which tests are / can be used to assess the requirements of Table 3 (mechanical properties).
- Table 12 covers requirements for when a machined sample is cut out of a bolt.
- Tables 9, 10 and 11 relate to studs and other non-standard bolts.

- Clause 9 covers 15 different test procedures. The test methods and what they are used for etc. are covered in this chapter.

The hardness issues (definitive comments):

- As previously stated, par 9.9 covers the hardness test requirements. It starts off with the following quote:

  "The purpose of the hardness test is

  - for all fasteners that cannot be tensile tested-to determine the hardness of the fastener
  - for fasteners that can be tensile tested – to determine the hardness of the fastener in order to check that the hardness is not exceeded."

- Hardness can be determined on a suitable surface (prepared suitably) or on a transverse section 1 diameter in from the end of the bolt. In a dispute only the latter readings are definitive.
- So ultimately what the document requires of bolt materials is: The material must conform in every way required by table 3.
- If the other tests are not possible (E.g tensiles, elongation, Charpy etc) then the hardness test rules. (You will see below that ISO EN 14399 which covers bolts for pre-tensioning contradicts the requirements for ISO 3269 Fasteners – Acceptance Inspection which does permit in some instances a very small percentage of 'lack of conformance' and what extra testing is required should tests find these situations).
- But even if all the other tests conform and hardness is exceeded then the bolt is deemed to have failed the requirements of 898-1.

ISO EN 14399: WE WILL NOW LOOK AT THE REQUIREMENTS OF THE VARIOUS SECTIONS OF ISO EN 14399 THAT WILL COMMONLY APPLY TO SOUTH AFRICAN CONDITIONS

Part 1: General requirements

The introduction and contents of Table 1 are described in the general comments of Part 1 of this article (See Steel Construction Vol. 35. Issue no 3 page 34).

Definitions: Assembly comprises matching bolt nut and necessary washer(s)

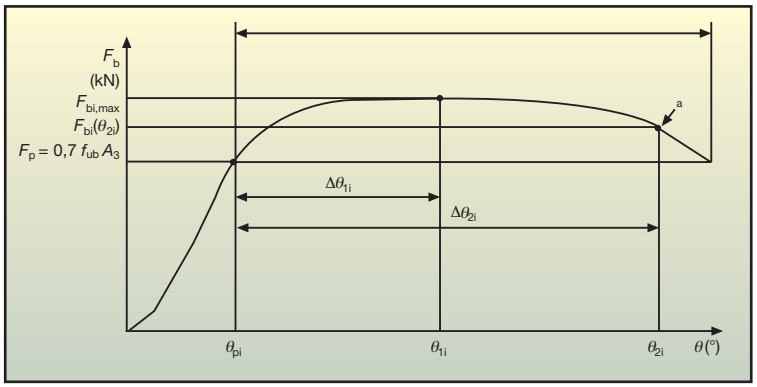


Figure 2: Rotation/bolt force curve.

Clause 3 sets about defining the differences between a

I. 'manufacturing lot' i.e. a batch of bolts using input material from a single cast to make bolts of one size (diameter and length), from one class grade processed through the same or similar steps at the same time or continuous time period through the same heat treatment processes (continuous system without change or batches in identical procedures). It is permitted to split the lot into a number of manufacturing batches and re-combine them into a lot.

II. 'assembly lot' assemblies bolts, nuts and washers are respectively supplied from a single manufacturing lot.

III. 'extended assembly lot' this is a manufacturing lot where the component that mainly influences the results of the suitability tests (described below) is combined with the other components from the same supplier chosen by a documented method.

NOTE: The component with the main influence is determined on the basis of the test results.

Clause 4.1 covers ordering requirements:

a) Quantities

b) Product designation

c) *K*-class (friction between nut thread and bolt threads). Default case *k0* applies (See below 14399-2 figure 3)

d) Other special requirements (low temperature etc.)

Clause 4.2.2 states those nuts shall be galvanized before they are threaded. Nuts shall not be re-threaded.

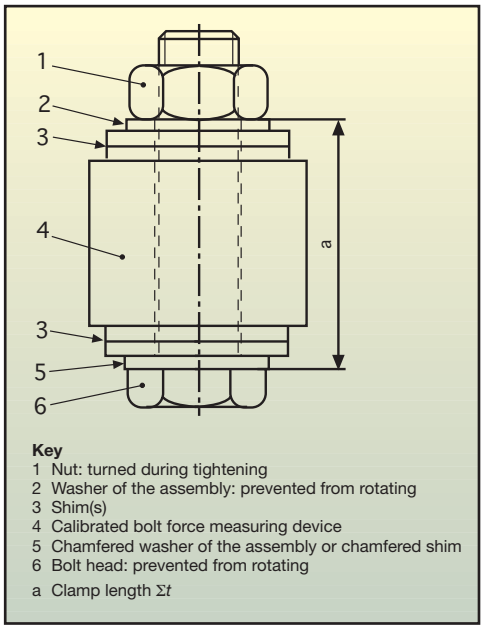
Clause 4.2.3 states that for 10.9 class bolts that are to be coated, steps are to be taken during the manufacturing process to reduce the risk of hydrogen embrittlement and that the threads shall be 'rolled threads' for this class grade. *(This would have implications for holding down bolts which are made from an EN material heat treated to be the equivalent of grade 10.9. Standard practice in SA is that typically HD bolts are made from a suitable EN8 or EN19 round bar, the threads are cut, not rolled, and then the bars are heat treated to produce the desired tensiles and other mechanical properties. Bad welding practice*

using these steels has led to numerous problems in the past.)

Clause 4.2.4 covers finish and coating and specifically states that hot dip galvanizing "shall be under the control of the manufacturer of the assemblies" *(i.e. it is not permitted to buy 'black bolts' from a bolt supplier and send them for galvanizing.)*

Clause 4.3 covers delivery conditions *(not a surprising clause as traceability is a requirement for these bolts):*

- Supplied in un-opened sealed container(s) as packed by the manufacturer of the assemblies *(The implication here is that a bolt supplier cannot hold large stocks and sell in small quantities drawing from his stocks unless he has a suitable QA system to ensure transfer of lot numbers etc. to small quantities.)*
- Certificates confirming suitability of assemblies for pre-loading to accompany deliveries (Tests in accordance with EN14399 part 2 described below). The manufacturer shall specify the suitable methods for tightening in accordance with ENV1090-1 *(This is the European equivalent of SANS2001 CS1. It is being replaced with ENV1090-2 in the foreseeable future. This document does not permit tightening using the "Turn of the nut methods" advocated by the SAISC.)*



Key
1 Nut: turned during tightening
2 Washer of the assembly: prevented from rotating
3 Shim(s)
4 Calibrated bolt force measuring device
5 Chamfered washer of the assembly or chamfered shim
6 Bolt head: prevented from rotating
a Clamp length Σt

Figure 1: Test set-up.

- There are two acceptable alternative forms of packing permitted:
  - Bolts, nuts, washers supplied by one manufacturer are packed together in one package and identified by assembly number and manufacturers ID. Certification that the assembly lot have been tested for suitability for pre-loading.
  - Bolts, nuts, washers supplied by one manufacturer are packed in separate packages labeled with lot numbers of the components and manufacturers ID. The elements will be freely interchangeable within the deliveries of one nominal thread diameter and certified suitable for pre-loading for an extended lot.

Clause 4.4 covers product requirements including:

- Dimensional tolerances
- Mechanical properties of bolts (Table 2) (i.e. elongation, UT, yield [stress at 0.2% non-proportional elongation], stress under proof load, strength under wedge load and hardness) shall be per EN ISO 898-1 and that impact strength shall be per EN14399- 3 or 14399- 4 (i.e. this is in addition to the tests required by EN ISO 898-1). This is further amplified in Table 10 which gives the applicable test name used in EN ISO 898-1.
- Mechanical properties of nuts both stress under proof load and hardness (14399-3 for HR system and 20898-2 for HV system apply). This is further amplified in Table 11 which gives the applicable test name used in EN ISO 898-1.
- Mechanical properties for washers i.e. hardness (14399-5 and 14399-6 apply). This is further amplified in Table 12 which gives the specification number for this test i.e. EN ISO 6507-1.
- Functional characteristics are further detailed in Table 13 and shall confirm that assemblies comply with maximum force during tightening test and the angle of rotation of the nut $\Delta\emptyset_2$ between the points indicated on figure 2 on page 43 (The figure is from14399-2). The results that are required to be recorded from a rotation test on an assembly are used to plot such result graphs from which the results are evaluated. *(Getting rather complicated to say the least!)*

Clause 4.4.5 tells us how to mark components of assembly and the letter H is used for bolts suitable for pre-loading. The addition of the letter R or V defines the system i.e. marking will be HR or HV *(i.e. grade 10.9S mark will disappear in future and be replaced by HR).*

Clause 4.5 makes some remarks and cross refers to corrosion protection documents.

Clause 5 covers dimensional tolerances, how to measure them and the like. It is also where you will find the tables 10, 11, 12 and 13 referred to and summarised above.

Clause 5.5 covers acceptance criteria:

"All fasteners tested for conformity evaluation **shall pass the tests** to be in conformance with this document." (ie. no non-conformance is permitted.)

Clause 6 covers "Evaluation of conformity":

Proof of:

- Initial conformity and type testing
  - on first use of the document
  - at the start of new or modified design assembly, raw material supplies
  - at the beginning of new or modified factory process
  - if the performance characteristics will not be affected when compared to previous tested lots this type of testing may be reduced. (As long as methods, sampling procedure, reporting system has not changed)
- Ongoing "factory production control including product assessment"

Clause 6.5.2 covers sampling requirements and is covered in Table 14 in detail (i.e. lists the tests referred to in 4 above) but can be summarised as:

- Initial testing 5 tests
  - per diameter
  - by manufacturing method,
  - by property class,
  - by coating type,
  - by material source.
- Periodic audit 5 tests per assembly lot

NOTE: All samples shall pass the tests.

Clause 6.3 covers factory production control (FPC) which should conform to the requirements of ISO 9001. The need for written manuals and methods, regularity of process control checking, keeping records, auditing the system, the need to use trained personnel, calibrated equipment, control of raw materials and the like are all covered.

Table 15 spells out the frequency of tests and recording requirements:

- For components (strength under wedge loading or hardness for bolts, hardness for nuts and washers) required in the FPC and translates into one piece per hour or continuous processes or one piece per batch.
- For assemblies 5 per assembly lot

Clause 6.3.8 calls for traceability being a specific requirement.

Clause 6.4 covers the minimum full audit requirements (twice in the first year) once per year thereafter subject to no major non-conformances occurring.

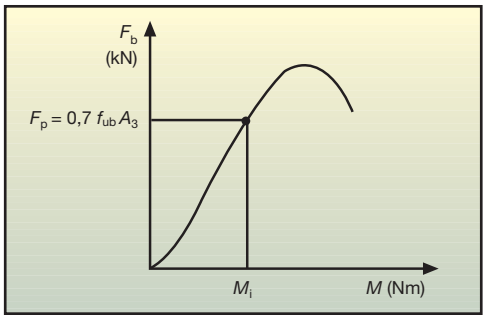


Figure 3: Torque/bolt force curve.

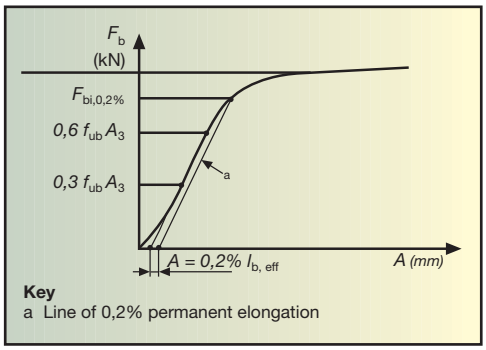


Figure 4: Elongation/bolt force curve.

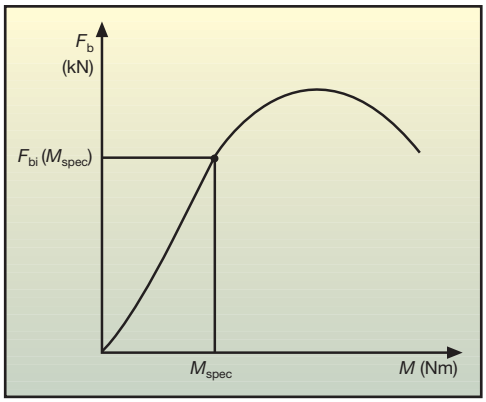


Figure 5: Torque/bolt force curve.

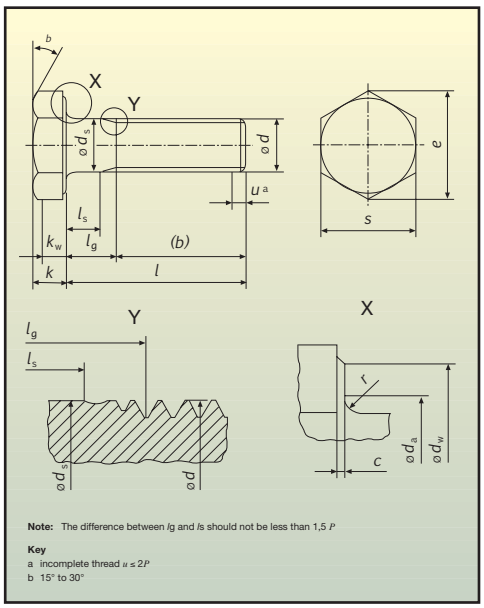


Figure 1 Part 3: Dimensions of bolts.

Annexure ZA is described as informative and covers guidance to conform with the requirements of getting the CE mark.

Part 2: High-strength structural bolting assemblies for preloading: Suitability test for preloading

Clause 1 covers the scope which is to verify the suitability of bolt assemblies for preloaded connections.

Clause 2: Normative references

Clause 3: Terms and definitions (no new ones)

Clause 4: 30 symbols and units are defined.

Clause 5 covers the principle of the test which is to tighten the assembly and measure the following parameters (figure 1 page 44):

- The bolt force
- The relative rotation between the bolt and the nut
- The torque (if required)
- The bolt elongation (if required)

Clause 6 spells out the requirements for the test apparatus.

Clause 7 covers test assemblies which should:

- Be taken from a 'single assembly lot' or from an 'extended assembly lot'.
- Each assembly shall be used only once.
- Unless otherwise agreed the test assemblies will be in the condition as supplied by the manufacturer without extra lubrication.

Clause 8 defines the test set-up rig as follows with the sophisticated bit being item 4 (load cells) (figure 1 page 44).

Chapter 9 covers the test procedure and covers:

- Temperature between 10 and 35 °C
- Rotate the nut continuously recording measurements throughout the test.

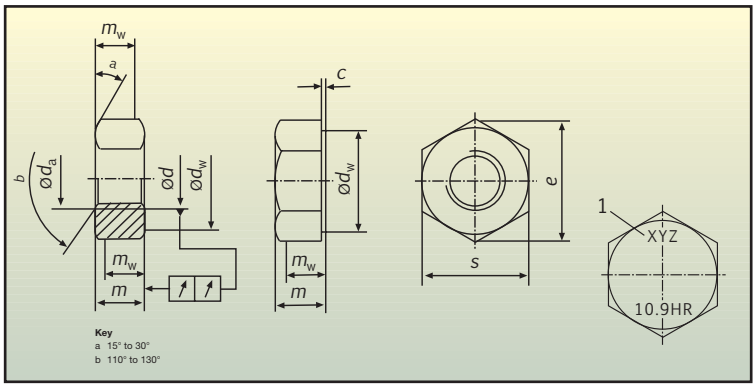


Figure 2 Part 3: Dimensions of nuts.

- Speed or rotation to be between 1 and 10 turns per minute.
- The bolt must not rotate nor the washer under the nut. If they do the test is invalidated
- The test stops when:
  - The angle of rotation exceeds requirements.
  - The bolt force drops to Fp (see figure 3).
  - The bolt fractures.
- The following curves shall be determined:
  - The rotation/ bolt force relationship (figure 3)
  - The torque / bolt force relationship (if required): figure 3 is used to determine k factors.
  - The elongation/ bolt force relationship (if required): figure 4 is used to determine 0.2 % strain.
  - The bolt force for a specified torque is determined from plotting figure 5.

Clause 11 covers the requirements for the test reports and shall include as a minimum the following:

- ID of the organisation and laboratory doing the testing
- Date of receipt of assemblies and date of testing
- ID number of the assembly lot or extended assembly lot
- Number of assemblies tested
- Designation and marking of the assemblies
- Coating and lubrication finish
- Test clamp length and other details of the test rig including rigidity
- Tightening conditions and speed of tightening, number of shims etc.
- Remarks concerning the tests
- That the test results are in accordance with the standard
- Evaluation of the functional characteristics of the tested assemblies in relation to the relevant product standard
- Conclusions

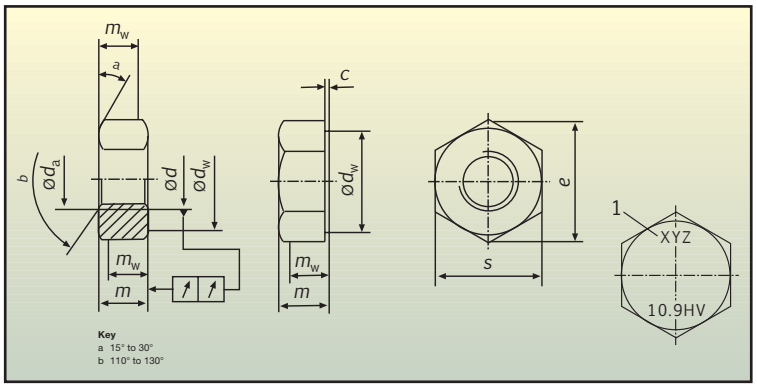


Figure 2 Part 4: Dimensions of nuts.

Annexure A gives information on how to deal with long bolts, short bolts, that the lubricant can be altered, what to do if the head of the bolt is the turned part (and not the nut) and finally that 'discontinuous tightening' is permitted.

Part 3: High-strength structural bolting assemblies for preloading- System HR-Hexagon bolt and nut assemblies

Clause 1 covers:

- Bolt and nut assemblies suitable for HR type applications i.e. (preloaded to 0.7 times the nominal tensile strength times the stress area), bolts in HSFG applications – from 12 dia to 36 dia. The bolts must be sufficiently ductile to achieve this condition.
- Bolts and nuts for both class 8.8/8 and 10.9/ 10
- Nuts are to be style 1 EN ISO 4032, thread length to be per ISO 888 (as per figure 2 below).
- Recommendations are made in ENV1090-1 for their proper application.

Clause 2: Normative references.

Clause 3: Dimensional information; specifying the bolts and nuts and their associated standards; proof loads for nuts; hardness of nuts; marking of bolts and nuts.

Clause 5 covers the correct (ordering) designation e.g. Bolt/ nut assembly EN14399-3 – M20 x 80-10.9/ 10 – HR.

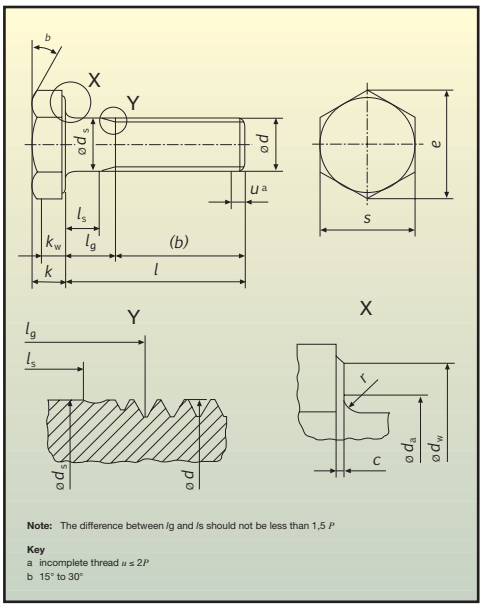


Figure 1 Part 4: Dimensions of bolts. *(Virtually the same as part 3 only length l_S varies between the two specifications.)*

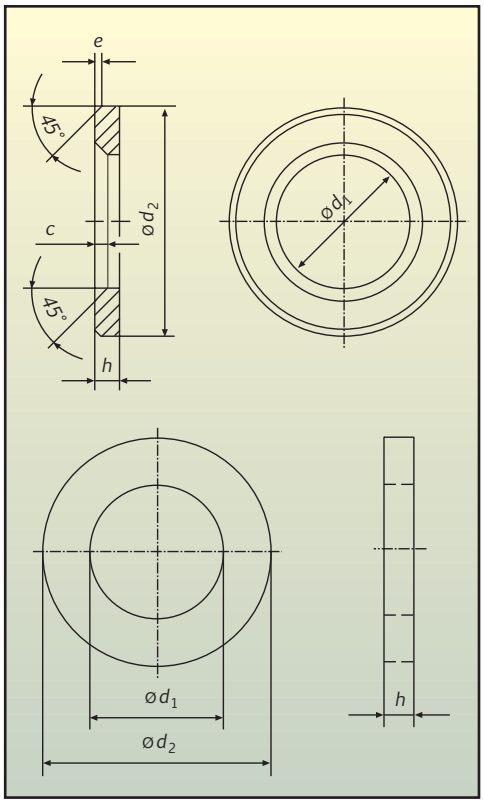


Figure 1: Dimensions.

Clause 7: Functional characteristics of the bolt nut washer assembly to be in accordance with ISO EN 14399-2.

- Maximum bolt force in testing is to be 0.9 x nominal tensile strength x stress area of the bolts.
- Table 7.4 covers the requirements for $\Delta\theta_2$ (see figure 2 on page 43) the required rotation of the nut at the higher stress levels.
- K1 class k factors are described.

Part 4: High-strength structural bolting assemblies for preloading – System HV-Hexagon bolt and nut assemblies

Clause 1 covers:

- Bolt and nut assemblies suitable for HV type applications i.e. (preloaded to 0.7 times the nominal tensile strength times the stress area), bolts in shear applications (the shear plane to be in the unthreaded shank) from 12 dia to 36 dia. The bolts must be sufficiently ductile to achieve this condition.
- Bolts and nuts to class grade 10.9/ 10 only.
- Nuts are to be 0.8d, thread lengths are to be 'short thread lengths'.

NOTES: The main difference in dimensions between HR and HV bolts/ nuts are:

- HV bolts have 'long unthreaded lengths' to allow for the shear plane to be in the unthreaded portion per European practice, HR has thread most of the length.
- HR nuts are thicker than HV nuts.
- Recommendations are made in ENV1090-1 for their proper application.

Clause 2: Normative references

Clause 3: Dimensional information; specifying the bolts and nuts and their associated standards; proof loads for nuts; hardness of nuts; marking of bolts and nuts.

Clause 5 covers the correct (ordering) designation e.g. bolt/ nut assembly EN14399-3 – M20 x 80-10.9/ 10 – HV.

Clause 7: Functional characteristics of the bolt nut washer assembly to be in accordance with ISO EN 14399-2.

- Maximum bolt force in testing is to be 0.9 x nominal tensile strength x stress area of the bolts.
- Table 7.4 covers the requirements for $\Delta\theta_2$ (see figure 2 on page 43) the required rotation of the nut at the higher stress levels.
- K1 class k factors are described.
- Because of the requirement for the shear plane to be well on to the unthreaded portion of the shank, a table of 'clamp lengths' for different lengths of bolts are specified in the code.

Parts 5 and 6: High-strength structural bolting assemblies for preloading: Plain washers and plain chamfered washers (Parts 5 and 6 are identical except part 6 has the dimensions for chamfered washers) (see figure 1 above).

The chamfers are intended for use under bolt heads and the chamfers are required to clear the radius(r) on detail X above. The specifications cover dimensions and hardness requirements, designation and marking.

CONCLUSION

There is no doubt that conforming to the requirements of ISO 898-1 of 2009 and 14399 parts 1-6 is presenting all bolt manufacturers (not only South African manufacturers) problems and the need to upgrade process controls that will ensure that hardness requirements are now met. SA bolt manufacturers are gearing up to meet these requirements and we are sure that it will not be long before they can proudly boast 'Buy South African' to meet the stringent requirements of the new European specifications.

For any enquiries regarding structural bolting issues in South Africa contact Spencer at spencer@saisc.co.za