

PROJECTS

MAGAZINE

AUGUST SEPTEMBER 2019



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HABITAT APARTMENTS



HEALTHCARE FACILITIES



HOSPITALITY DEVELOPMENTS



INDUSTRIAL DEVELOPMENTS



INSTITUTIONAL DEVELOPMENTS



MIXED USE DEVELOPMENT

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Contributions

The editors welcome news items, press releases, articles and photographs relating to the Construction Industry. These will be considered and, if accepted, published. No responsibility will be accepted should contributions be lost, damaged or incorrectly printed.

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Habitat Apartments – Kenya by Parklane Construction Limited + Design Source Limited and Paragon Architects of South Africa



Under development by Ekco Investments, a collaboration between Design Source Ltd, an architecture and Interior Design Firm in Kenya, and Paragon Architects of South Africa are overseeing Habitat Apartments in Kilimani, a 24-storey, 112-unit mixed-use apartment tower.

'When the client first approached us they were clear that they wanted a world class building, in which we had no doubt in our minds who to work with on this project and that is how the collaboration with Paragon came about',

explains Chris Naicca, Director at Design Source Ltd.

There is a sense of an almost overbearing indulgence, mixed use apartments predominantly residential from studio apartments to three-bedroom duplex units, exploring the same level of spatial discipline as the largest penthouse at the very top. The scheme affords an integrity of spatial design that only reinforces how apartment living in Nairobi should be explored, simple and unpatronising, but is a conscious effort at reinterpreting the Kenyan aspiration of modernity within the wider context of Africa. The project is, in turn, an attempt to bring architecture in Africa to the world stage.

Design Brief

"The design brief was for a tall building that maximised the development potential, while containing excavation and foundation costs. At first, the project was envisaged as a long-stay apartment-hotel." explains Paragon Founding Director Henning Rasmuss, who attended the official site-handover ceremony on 8 November 2017.

The building's verticality has been emphasised in the planning and massing through a series of linear signatures on the façade, multiply



occurring on lighting fins, façade openings and an overall perforated concept to the building that fades as the building rises. It is doubly intricate, as these patterns have been explored as part of the identity of the client team as a whole, from the podium's blue stone, to the cladding that hints at a modern take on the scheme.

Habitat Apartments "rethinks the concept of a vertical village" in a site that straddles the upper-hill of Nairobi. "The idea was to be as efficient as possible, and afford the city perhaps its first vertically-articulated building," Paragon Architect's Edwin Seda comments.

The perforations borrow their idea from a need to give the building an identity that ties back to the client, with the exploration of the DNA strand explored as dots that represent the client's team, which in turn has been abstracted into these perforations. The multi-functional duality here is that these screen abstract the identity of a modern African 'habitat', but still act as light wells and harbours for controlled views and extravagant ambience.

"The location of the project inspired the type of design. The site is within Upper hill area of Nairobi which is a very strategic location. The buildings of similar height in Upper-hill are all commercial. We had to come up with a look and feel that can fit in with the commercial buildings yet carry the different function of being serviced apartments. The ambition of the

client to have a world class building also inspired the design to take on the look and feel that we have achieved", explains Hudson Ng'ang'a from Design Source.

Exterior

The main raw material used, Nairobi blue stone, added an element of 'cubic permeance' to the scheme. The brise-soleil articulation of the stone took a simple material and advanced it a step further in how traditional materials are used in the modern age. "This is especially important as an aspect of identity, and to



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reduce the carbon footprint,” Seda notes.

The brise-soleil articulates the podium and shapes the building, while at the same time shading the parking structure and allowing these spaces to 'breathe'. The total green area – comprising planted sections vertically across the building – accounts for 30% of the site, including the landscaped street interface, the planted podium on the entertainment level, and the rooftop entertainment level gardens, which comprise 430 m² of the 1 400 m² site.

With roof gardens, cubic permanence in the podium and tower, and an overlay of different scales to the façade, the scheme has been grounded in the city with little victories here and there that come together and allow the scheme a vibrant contact with the street, neighbourhood, and the city as an extended canvas.



“This was important in ensuring a somewhat 'giving back the green' approach. Taking the planted screen into consideration, the ratio almost balances out at a 50/50 percentage of building coverage to site greening,” Seda reveals. Lighting was also a key element. The striped façade introduced a new multiple identity, with each floor transitioning seamlessly into the next. The intimate balconies, tucked away from the streets as somewhat internal amenities, are really just nooks that spill out from the internal spaces, and are terminated only by the façade, which stops short to stagger the planes vertically.

Challenges Faced

“We have had challenges with the size of the site and the nature of the site. During excavation we encountered a portion of the site that had some hard rock not previously picked up by the Geotechnical surveys, but we worked with the engineers and the excavations contractor quite well to manage issues relating to cost and time. The size of the property was also a challenge as it minimized the frontage that we have for the building with regard to its relationship with the street but we have managed to create wonderful visual interaction with the overall perforated concept being applied even at street level”, concludes Hudson. The project is scheduled for completion by mid-2020.



HOSPITALITY DEVELOPMENTS



Four Points By Sheraton
Jomo Kenyatta International Airport
Nairobi, Kenya
Year: 2015 - 2017
Project cost: Kshs. 991 Million
Status: Completed

The project development site lies overlooking Jomo Kenyatta International Airport, and enjoys magnificent views of the Airport terminus surrounded by breathtaking envisaged with natural landscapes.

The project has set a new benchmark in Nairobi's hotel industry combining leisure, business and sports and lifestyle accommodation.

The Development comprises of 1 basement with service areas and parking, ground floor with reception, meeting rooms and restaurant. 5No. hotel room floors with 173 bedrooms consisting of deluxe twin/deluxe double/suite twin, suite double, junior suites, executive suite. swimming pool and pool terrace in 5th floor. The development has a gross area of (approximately) 12,599 SQM.

Parklane Construction Limited was commissioned for the hospitality development for this state of the art facility.

INSTITUTIONAL DEVELOPMENTS



International School of Kenya (ISK) Basketball Court Nairobi

Nairobi, Kenya

Year: 2017

Project cost: Kshs. 91 Million

Status: Completed

This conventional complex with a unique yet receptive design creating an iconic sports facility which has set gauge for the International School of Kenya. The facility entails to provide for a spectator seating which can accommodate large capacity in addition to male and female changing rooms.

Parklane Construction Limited was appointed for the construction of this ultra modern building at the helm of Nairobi.

INDUSTRIAL DEVELOPMENTS



Completion of Factory and Godowns for Africa Spirits Ltd.

Thika, Kenya

Year: 2013 - 2014

Project cost: Kshs. 296 Million

Status: Completed

The project was well crafted and the scope involved intensive study of production line techniques and incorporation of state of the art packaging facilities and sophisticated fire safety precautions. Parklane Construction Limited was given an assignment for the construction of this modern Warehouse which was completed within the time frame.

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HEALTHCARE FACILITIES



Avenue Health Centre
Parklands, Nairobi, Kenya
Year: 2016 -2017
Project cost: Kshs. 622 Million
Status: Completed

Designed to provide customized doctors' offices and private healthcare facilities. The newly planned hospital building is also offering laboratory and physiotherapy facilities, private consulting suites and a new administration center. The facility is also offering private ward accommodation and medical practitioners with ease of access to their patients. Having acquired enough knowledge related to healthcare facilities, we were appointed for the construction of this ultra modern state of the art building located at Parklands with 1 Basement and 8 floors.

MIXED USE DEVELOPMENT



**Proposed Offices & Warehouses
Development for Stansfield at JKIA**
Nairobi, Kenya
Year: 2017 - 2019
Project cost: Kshs. 390 Million
Status: On going

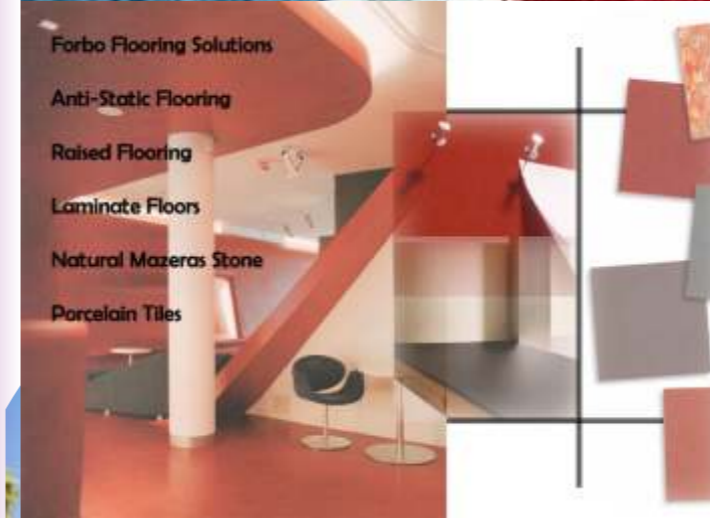
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INTERIOR FIT- OUTS

FIT OUTS - COMMERCIAL INTERIORS



Interiors Fit outs at HHM, 1- 4 Floors
Waiyaki Way at Delta Building, Nairobi, Kenya
Year: 2015 - 2016
Project cost: Kshs.89 Million
Status: Completed

The open plan office areas depict a contemporary working environment with break out spaces being centralised and brightly furnished. LED lighting is a dominant feature in the lobby areas while the walls and bulkheads are continuous throughout the interior space. The design factors have been based on the organisation's vision and include; colour scheme, space planning, texture of finishes and material usage which aim at further establishing corporate identity and the organisation as a whole. Having a wide experience on interior office fit outs we were appointed to carry out this assignment which consisted office fit outs to 4 floors

FIT OUTS - COMMERCIAL INTERIORS



Internal Office Fit out at Karen Watermark office suite
 Nairobi, Kenya
 Year: 2014
 Project cost: Kshs.34 Million
 Status: Completed

Parklane Construction Limited won the competition, to carry out the scope of works which involved creating an open plan office spaces with all the necessary interior fits outs to 1 floor. The office is located at the hear of Karen and sits on expansive well landscaped area.



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Habitat Apartments under construction

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FIT OUTS - COMMERCIAL INTERIORS



Interior Office Fitout for Dhanush Infotech
 Rahimtullah Tower, Nairobi, Kenya
Year: 2013
Project cost: Kshs.25Million
Status: Completed

Parklane Construction Limited was appointed for the construction and fit out of contemporary offices on behalf of multinational organisation for Dhanush Infotech Ltd. The new offices are situated at Rahimtullah Tower, Nairobi, Kenya.

The project design and construction took direction from the clients overall requirements in terms of employee numbers, their roles, working practices and corporate brand identity. The scope of work consisted office fit outs to 1st floor.

FIT OUTS - COMMERCIAL INTERIORS



Interior Office Fitout for Dhanush Infotech
Third Floor
 Rahimtullah Tower, Nairobi, Kenya
Year: 2014
Project cost: Kshs.25 Million
Status: Completed

Parklane Construction Limited was again commissioned for the construction and fit out of contemporary offices on behalf of multinational organisation for Dhanush Infotech Ltd in Rahimtullah Towers. The offices are comprised of a number of meeting rooms, boardroom, cellular offices, open plan work spaces, a reception area among others. scope of work consisted office fit outs to 3rd floor.

FIT OUTS - COMMERCIAL INTERIORS



**Interior Office Fit out for Copy Cat Ltd,
1-3 Floors**
Encee Place – Muguga Green,
Nairobi, Kenya
Year: 2014
Project cost: Kshs. 33 Million
Status: Completed

We were commissioned for the construction of this contemporary office, conceived as elegant, functionally efficient and vibrant in nature responding to the need for natural day lighting, natural ventilation with playful and creative details for an open plan arrangement. The scope of work consisted office fit outs 1st to 3rd floors.



FIT OUTS - COMMERCIAL INTERIORS



Interior Office Fit out for KRA
CBC Upperhill, Nairobi, Kenya
Year: 2017
Project cost: Kshs. 686Million
Status: Completed

Parklane Construction Limited was awarded an interior fit out contract which was developed with Strong graphical representations applied onto walls, floors and furniture by the use of non-conventional media. A rich colour palette was incorporated of browns, deep red, as per client instructions. Sleek and uncluttered interiors reveal the forward moving and contemporary approach of the organisation. The building presented a unique floor plan, walls and sharp angles which were brilliantly overcome through systematic space planning.

FIT OUTS - COMMERCIAL INTERIORS



Proposed Office Partitioning Works For Africa Spirits Limited (ASL)

Thika, Kenya

Year: 2015-2016

Project cost: Kshs. 32 Million

Status: Completed

Parklane Construction Limited was appointed for the construction of a fast track project comprising design adaptation to create a simple but elegant state of the art office. Security, electricals and the like had to be interlinked on a different floors within the same building. Sound-proofing, low maintenance materials, allowance for flexible furnishing in offices and room for growth has been taken into design solutions, especially with services.



FIT OUTS - COMMERCIAL INTERIORS



Interior Office Fit out for Messrs Druv Ceramics Ltd

Kijabe Street, Nairobi, Kenya

Year: 2015-2016

Project cost: Kshs. 15 Million

Status: Completed

Parklane Construction Limited was appointed for the renovations of Dhruv Ceramics which is located along Kijabe street. The works carried out has given the office a new look thus creating a theme mood for clients interactions



PARKLANE CONSTRUCTION LTD 2018

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SKF appoints Niclas Rosenlew new CFO

Niclas Rosenlew has been appointed Senior Vice President and CFO of AB SKF. Niclas will start his new position on 17 June 2019 and replaces Christian Johansson, who leaves SKF with immediate effect, to pursue his career outside the company.

Niclas Rosenlew is currently CFO of Basware. He was born in 1972 and holds a Master of Science in Finance from Hanken Swedish School of Economics. His previous roles include senior positions within Microsoft, Nokia and Deutsche Bank.

Alrik Danielson, President and CEO, says: "We are delighted to welcome Niclas to SKF and Group Management. His extensive operational, investor and strategic experience, combined with his leadership skills, will be important in our continued development."

"I would like to thank Christian for his valuable contribution and wish him the best in his future professional endeavors."

Alrik Danielson will assume the role of interim CFO until 17 June 2019.



SKF appoints new CFO, Niclas Rosenlew.

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"These products will be supplied, serviced, and maintained mainly through our Light Equipment dealer network, a footprint that is developing positively and in-line with our roll-out plan," confirms Marthinussen.

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SKF supplies mill pinion assemblies for a SAG mill in Russia

SKF supplied locally manufactured mill pinion assemblies including in-house designed bearing housings as well as a Taconite sealing solution to a longstanding customer in the local grinding mill sector intended for a 22x14 ft. SAG mill at a gold project in Russia.

Project Engineering Team Leader at SKF, Janus Bezuidenhout, explains that the design for this very specific high load application needed to fulfill performance expectations and allow for the required modifications. In March 2019, SKF's project engineering department supplied an assessment report on the re-designed mill and recommendations on the scope of work.

As the customer re-designed the mill with new requirements, SKF had to provide calculations on the expected life cycle of the bearings and load ratings for the bearing housings. The customer decided to convert from a grease to an oil circulating lubrication system for the application which is operating with open spherical roller bearings to allow for misalignment of the pinion to the girth gear by means of the helical pinion gear. "We therefore recommended our robust and cost-effective Taconite sealing arrangement which is ideal for oil circulation systems," affirms Bezuidenhout. He adds that there are several SKF oil circulating taconite sealing arrangements operating in a number of applications with great success.

According to Bezuidenhout, SKF's innovative solutions have impressed the customer who confirmed that the proposed housing and seal design would exceed the expected life at a cost that would make them competitive. "These advanced innovations will not only enhance

uptime but will also save on total cost of ownership." This order is currently in the manufacturing phase with SKF-approved suppliers fabricating the various components. The foundry for the castings is based in Kimberly, Northern Cape, whilst the machining of the housings and component manufacture are being completed in Boksburg, Gauteng.

Delivery of the complete order is expected at the end of August 2019. In order to achieve this rapid five month turnaround, Bezuidenhout says that SKF's engineering and sales departments collaborated seamlessly. "We always place our customers' needs first and will tap into all our networks to ensure that we deliver the optimum solution to grow their business's productivity and profitability levels."

As the customer has many years of experience as a specialist in the mill industry, they will be responsible for the installation and commissioning. However, SKF will support the customer by providing the necessary information on tooling requirements as well as assembly and pinion commissioning procedures.

Wrapping up Bezuidenhout says that "Recognising the tough conditions of the SAG mill environment at this gold project in Russia, we were confident that our rugged SAG mill pinion assemblies are the optimal solution for this application. Through our exceptional local capabilities, internal team efforts, superior quality products and service solutions we are able to remain customers' preferred bearing and rotating technology partner."

SKF invests SEK 450 million in deep groove ball bearing manufacturing

Staff reductions connected to automation investments in Bari will result in restructuring costs of approximately SEK 140 million in the second quarter of 2019.

SKF is investing approximately SEK 450 million in improving the competitiveness of its deep groove ball bearing (DGBB) offering. This includes shifting some production from Bari, Italy to Asia and Eastern Europe. DGBB manufacturing in China is to be consolidated into a new factory and an automated production channel is also being implemented in Bari.

Balancing the Group's regional manufacturing footprint continues to be a focus. In-line with this ambition, an investment totalling approximately SEK 370 million is being made in a new DGBB factory in Xinchang, China. This will enable continued growth and footprint consolidation in China. The new factory is expected to be fully operational during the first half of 2020.

Patrick Tong, President, Industrial Sales, Asia, says: "Through this investment we will increase our competitiveness in Asia. Having already moved the Group's global product development for DGBB from Europe to China, we will now be

able to step up our full value chain approach to serve local customer and application needs."

The investment in the Bari factory totals approximately SEK 50 million and will lead to the automation of manual operations and a flexible and more competitive manufacturing process. Associated staff reductions will result in restructuring costs of approximately SEK 140 million, to be accounted for during the second quarter of 2019. The automated production channel in Bari is expected to be completed during the second half of 2020.

Approximately SEK 30 million is being invested in technology and capacity upgrades in existing factories in Asia and Eastern Europe.

Kent Viitanen, President, Bearing Operations, says: "We are deploying one of the worlds most advanced, flexible and fully automated assembly lines of its kind in Bari. This enables a reduction in resetting time from hours to minutes, meaning much greater flexibility and improved customer service levels. The investment will also contribute to improved quality and allows us to develop the technical competence of our staff."



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We also use Southern African Wildlife College (SAWC) by Orphen gate. Here groups of up to 30 can be accommodated and trained. Accommodation and meals are included.



Finding fault: determining the true cause of premature bearing failure

Premature bearing failure is often blamed on 'white etching cracks' – but looking deeper for the true underlying cause will lead to a more effective solution, says Erik Vegter, Senior Scientist for Fatigue Modelling and Testing at SKF.

Modern manufacturing practices, and techniques such as predictive maintenance, have helped to make premature bearing failure a rare occurrence. However, it can still happen and, when it does, can have a catastrophic effect. The most worrying thing is that some failed bearings are nowhere near the end of their calculated lifespans and may only have operated for 5-10% of their rated life. This is a source of great expense and annoyance to customers, who expect their bearings to last for their calculated lifetimes and beyond.

Some applications, such as wind turbine gearboxes have shown to be more prone to early bearing failure than others. The important

thing for customers is to diagnose the failure and correct it. However, there has been plenty of debate over the exact causes of early bearing failure.

One common feature of premature failures is a network of small, white decorated cracks below the surface of the bearing, so-called 'white etching cracks' (WECs) or small axial cracks visible at the raceway surface. At first sight, it makes sense to assume that these are the cause of the problem, as they are seen in most cases of premature bearing failure.

However, an extensive, four-year research project carried out by SKF has shown that in reality these cracks occur at the end of the failure chain and are a natural consequence of crack networks in prematurely failed bearings. The company's specialists concluded that WECs are only a visible symptom of the failure, and not part of the underlying cause.

SKF has so far identified seven mechanisms that cause premature bearing failure, leading to one common result: shorter bearing life as well as the appearance of WECs. As a consequence, SKF has developed a scheme to classify premature bearing failures, to help application engineers work together with customers to find the true root cause of the failures and, consequently, the most appropriate solution.

Despite this new insight, some premature failures are still being assigned to WECs and resolved on that basis (usually by replacing the failed bearing with an identical one). However, rather than needlessly repeating this approach, it is vital to drill down into the problem and pinpoint the underlying reason for failure. The SKF research has identified a series of

underlying causes, allowing more accurate solutions to be found in each case.

Project details

The project involved replicating the exact conditions seen in bearings that failed in the field and subjecting them to extensive laboratory tests (including optical and scanning electron microscopy, and ultrasonics). Making the bearing fail under controlled conditions, helped SKF to pinpoint exact failure mechanisms, allowing a more accurate and targeted solution to be found to each problem.

For each root cause, SKF systematically reproduced the critical operating conditions on a test rig. This allowed them to know for sure which particular conditions caused WECs and allowed a link between the cracks and, for instance, structural stresses to be proven. The project has allowed SKF to clarify the role of WECs in relation to both classical bearing rolling contact fatigue and accelerated fatigue (accelerated spalling of bearings).

In bearing rolling contact fatigue (where there is no premature failure), WECs are generally caused by cyclic stresses and loading. However, the more extensive appearance of WECs is seen in accelerated fatigue, which can variously be assigned to higher stresses, lower material strength and/or a mixture of friction and lubrication effects.

WECs are cracks within the microstructure of bearing steel. They are so named because of the white appearance of the altered microstructure of a polished and etched steel sample. The affected areas incorporate ultra-fine, nano-crystalline, carbide-free ferrite, or ferrite with a very fine distribution of carbide particles. White etching areas (WEAs) are formed by amorphization due to friction at the crack faces during over-rolling. These areas appear white under an optical microscope, due to their low-etching response to the etchant. White etching areas around cracks are 10-50% harder than the surrounding (and unaffected) microstructure.

Classification scheme

SKF has developed a scheme to classify bearings failures using its new approach. This helps to suggest a particular solution, based on the more accurate diagnosis. For instance, if the

failure was caused by lubrication problems or tribochemical effects, SKF may recommend moving to a black oxide coated bearing. Other failure modes, when identified, may lead to recommending solutions ranging from high strength stainless steel to hybrid bearings.

Overall, the research has been well received, with only minor disagreement on some of the details. There is certainly no debate on the main thrust of the argument, that white etching cracks come about through different failure modes. However, there is still more work to do: SKF has not yet replicated the conditions under which bearings fail due to electrical currents, for example, and so these experiments are ongoing in the company's laboratories.

Solutions

The focus on finding new failure modes has now shifted towards developing better solutions. Through increased research and development, SKF is looking for the best materials and heat treatment combinations that can better cope with each failure root cause.

As well as developing a list of underlying causes for failure, SKF has come up with a range of general recommendations, based on the categorisation of the weakening drivers into 'higher stress' and 'lower material strength'. The recommendations distinguish between those for the application itself, such as the bearing system or the design process, and on the possibilities to further increase bearing robustness. The option that is most effective in preventing premature failure will depend on the specific circumstances of the application.

In wind turbine gearboxes, SKF black-oxide bearings have meanwhile proven to be a robust solution in this challenging application. Black-oxidized bearings are delivered in high volumes to the wind market for more than a decade, on the most critical bearing positions to all major gearbox manufacturers and a very low failure rate has been reported (< 50ppm, based on more than 260 000 bearings in the field).

The robustness increase of black-oxide can be explained by the unique combination of





SKF Senior Scientist for Fatigue Modelling and Testing, Erik Vegter

and enhanced smearing resistance. The risks of fretting, micropitting and cracks can be limited. Resistant to corrosion and chemicals, black oxide bearings reduce the effects of moisture and aggressive oil ingredients. They also help improve friction behavior and reduce wear, particularly under mixed friction conditions which are present in wind gearboxes. When running under proper lubrication conditions, field examples have shown that the black oxide layer looks nearly intact after several years of operation, even in the low speed section.

Each premature bearing failure is unique and there are many potential reasons for premature spalling. There is no single root cause, and each failure case must be reviewed according to the relevant operating conditions. Understanding this and moving away from a diagnosis of white etching crack failure will help to ensure more accurate diagnosis of the problem, and a speedier solution.

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properties countering the most severe operating conditions in the gearbox. Lab tests have shown a better performance in poor lubrication situations and high slip conditions because the treatment delivers improved lubricant adhesion

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Celebrating 100 years of the spherical roller bearing

The spherical roller bearing, that helps engineers accommodate heavy radial and axial loads in applications prone to misalignment or shaft deflections, celebrates its 100th birthday this year thanks to SKF.

Originally developed in 1919 by an SKF engineer, Arvid Palmgren, the spherical roller bearing (SRB) has since made its mark worldwide.

Created to complement the self-aligning ball bearing, due to its ability to accommodate misalignment under heavy loads, the initial SKF design has now become part of the largest family of products in the industry.

On the fabled Las Vegas Strip in the US, the High Roller ferris wheel contains two of the largest SRBs ever produced by SKF, each weighing in at 8.8 tonnes! SKF spherical roller bearings can be found in many applications, including some where you might not expect them. A good example is the Bahrain World Trade Center, where three tower wind turbines, each 29 metres in diameter, are architecturally installed between the two 240-metre-high (50-storey) towers and generate 1,300 MWh per year. The main shafts of the turbines were equipped with SKF spherical roller bearings. The turbines went online in March 2008 and are operational 50 percent of the time, depending on wind conditions. Another alluring application fitted with SRBs is the rebirth of the Zeppelin after 60 years of absence following the Hindenburg disaster. SKF was brought in by ZF, the gearbox manufacturer for the Zeppelin NT, to help the new and improved airships to propel forward.

SKF's extensive SRB range delivers a range of benefits for specific operating conditions. For example, operators in contaminated

environments in heavy industrial applications have increased their bearing rating life by up to four times with sealed SKF spherical roller bearings. Those working in the harshest of environments have benefitted from SKF's Three-Barrier Solution that delivers cost-effective, optimised rating life, minimal maintenance spherical roller bearings. New dimension gearbox design has even become possible thanks to SKF Explorer SRB's long service life and high performance.

Petra Öberg Gustafsson, Product Line Manager Self Aligning Bearings at SKF comments: "From the very start, SKF has taken the lead in the development of self-aligning bearings. We introduced spherical roller bearings in 1919 and have been consistently improving them ever since. Building on Arvid Palmgren's original design, we now offer engineers the widest range of both open and sealed spherical roller bearings in the industry. With the continued push for high performance in ever more challenging environments, it will be interesting to see what the next 100 years of development generates!"



Customised and hybrid bearings solve fundamental issues in electric vehicles

The high speed of the electric motors used in EV&HEV powertrains requires the use of customised bearings. Ceramic ball bearings are most capable of dealing with all the specific conditions, says Anthony Simonin, EV and HEV Competence Centre Manager at SKF.

Gothenburg, Sweden, 17 May 2019: On the surface, there appears little difference between an electric and hybrid vehicle (EV&HEV) and the conventional car, powered by an internal combustion engine, that it will increasingly replace.

However, beneath the chassis, the gulf is huge, with the most fundamental shift being in the drivetrain. Here, powerful electric motors provide the power, and the way in which they work, and how they connect to the rest of the car, requires critical components such as bearings to be redesigned or adapted to work in this new environment.

For instance, the motor itself must run at very high speed, far faster than it would in a conventional industrial application, meaning that bearings within it must be able to cope without failing. In general, this has been solved by adapting conventional steel ball bearings, such as by redesigning the cage and using special lubricating grease.

A typical EV uses up to four motors, if each is connected to a separate wheel. These run at up to 30,000rpm, which is around three times the speed of a typical industrial motor. This puts an enormous strain on the internal bearings, so these will need to be replaced or adapted.

One way is to redesign the bearing and the polymer cage, adapting the fundamental design. This ensures that the overall bearing configuration can withstand the higher speed, acceleration and temperature that we can see in these applications.

In addition, the higher speeds require more efficient lubrication. Here, special greases are required that can keep their viscosity and so continue to be effective lubricants at these higher speeds and temperatures.

While the electric motor, in combination with an inverter, ensures high efficiency, there is one feature that can affect conventional steel bearings. The high-frequency voltage switching of the inverter, which in turn causes current leakage. The current can end up being conducted through the bearings. This can cause problems such as surface pitting, and subsequent catastrophic failure.

In a sense, the problem is caused by running the motor in its most efficient way: increasing

motor speed boosts power and efficiency, without having to increase current or torque. However, increasing the speed also increases voltage frequency, which leads to electrical discharge.

The sensible answer is to use a ball bearing that is naturally insulating and will not conduct a current.

Ceramic balls

Switching conventional steel balls for their ceramic equivalent, to make a so-called hybrid bearing, is a recognised way of solving this problem, because the ceramic balls are naturally insulating. However, due mainly to their higher cost, only a small number of EV designers incorporate hybrid bearings in their designs.

At SKF, we estimate that only around 5% of bearings in these applications are hybrid ones. Typically, these hybrid bearings have only been specified because of the earlier failure of steel bearings in these applications. Very few EV designers specify hybrid bearings from the beginning, but we see that this is beginning to change.

The main reason that designers will not design in hybrid bearings from the start is that they cannot justify the extra cost. They are generally unable to predict the failure of the conventional bearings, so prefer to run them until they fail.

However, some of the larger EV manufacturers use sophisticated simulation software to model the exact conditions experienced by bearings in these applications. Using this software, they are able to see, and quantify, the amount of current leakage and its likely effect on the bearings. If it makes financial sense, they will replace conventional steel bearings with hybrid ones. Around five years ago, hybrid bearings were rarely designed in from the start. Now, it has become more common, and is likely to increase further.

Replacing conventional bearings with hybrids is generally painless, as the hybrid bearings have identical dimensions to conventional steel bearings. At the same time, the necessary design amendments, to the cage and grease, will already have been made.

In addition to their insulative properties, ceramic balls have other advantages: they are 40% less dense than their steel equivalents, which means they can run at cooler temperatures; they can have up to 10 times the life expectancy; and they require less lubrication. These advantages go some way to explaining their higher cost.

One premium user of SKF's hybrid bearings is an automotive customer, who first specified SKF's hybrid bearings back in 2014.

As well as resisting the effects of arcing, the hybrid bearings ensured higher efficiency, due to their lighter weight and greater hardness. Overall, the higher efficiency helps EVs travel further on a single charge, a key criterion of success as EVs compete with conventional cars.

Into the future

There is no escaping the fact that hybrid bearings are expensive. At SKF, we are looking into alternative solutions, and developing a way of solving the problem of electrical damage to bearing, but without using ceramic balls.

The answer is to create another path for the current, so that it does not pass through the bearing itself and damage it. At the moment, this technology is still under development, so we do not yet have any specific details to share.

There is another reason for developing this new technology: despite their huge advantage, ceramic balls do not completely solve the problem of current leakage. While they resist the effects of surface damage, the current can still work its way to the gearbox and cause damage there, such as by destroying the spline connection. We expect our new development, which is due to be launched by the end of this year, to solve this problem while also being cheaper than using a hybrid bearing. SKF is not married to any particular technology but provides specific solutions to design problems. Right now, our hybrid bearings can help overcome problems of current leakage in EVs; soon, we will have a new technology that promises to do the same, but at a lower price.

We supply products such as bearings to most EV manufacturers in the market. So already





which is the case with some of the larger manufacturers, they will be able to 'design out' the problem at the source.

For other manufacturers, who may design the motor, but source other components such as the control unit and gearbox externally, this will be impossible, and they will need to continue using solutions such as hybrid bearings.

Electric vehicles are the way ahead for transport. Though they still account for a relatively small part of the market, making them as efficient and reliable as possible. Through the design of components such as bearings, will help to take a larger share of the market.

Press release about our appearance at this year's International Electric Vehicle Symposium (EVS 32):

Advanced bearing technology for electric vehicles to be showcased by SKF

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have a deep insight into these applications and know how to solve their associated problems.

Looking further forward, some EV manufacturers may be able to overcome the problem of current leakage completely. If they are responsible for designing the full system,

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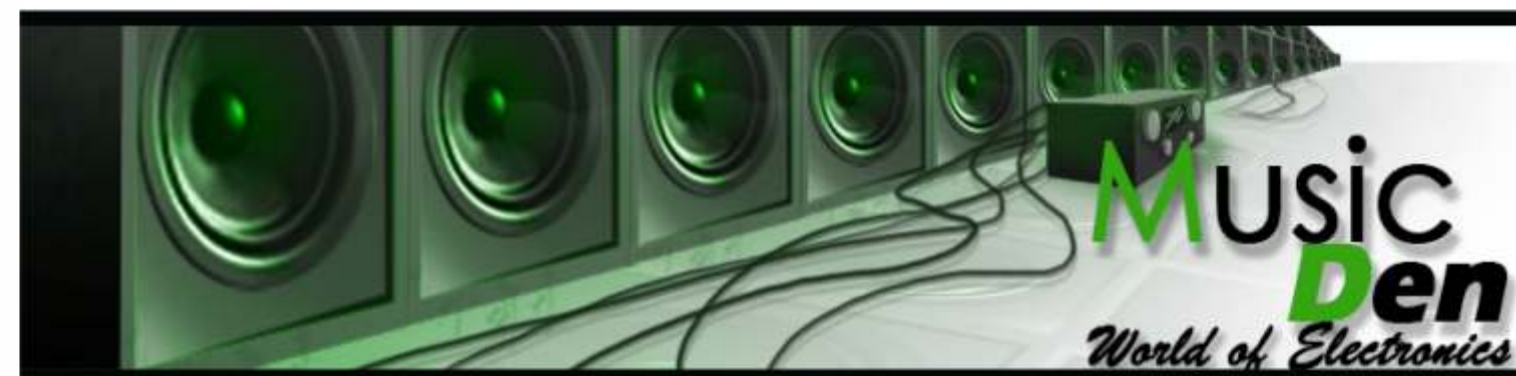
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