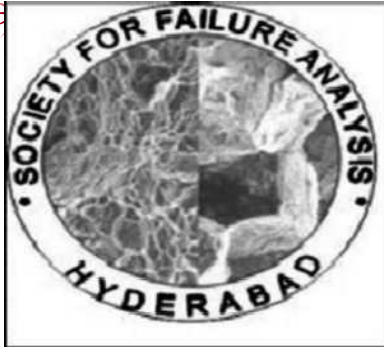




SFA Newsletter

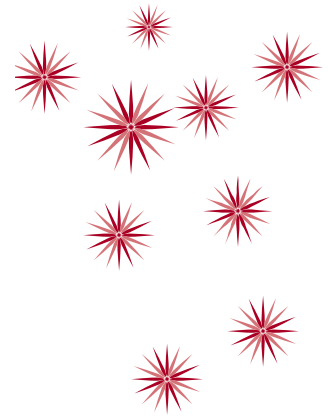
Seasons Greetings!

[About SFA](#)

[Objectives](#)

[Local centers](#)

Welcome you all to join as members of SFA! Please find the membership form inside; kindly fill in and contact Secretary of SFA through email.



Message from our President

Dear readers,

Happy New Year 2020!

I take this opportunity to wish you all and a very prosperous and eventful year ahead! Every New Year gives us an opportunity to recall what we achieved previous year and to prepare plans for the next 12 months. Apart from others, we successfully conducted Clinic on Failure Analysis (CFA-2019), UFEM-2019, and Inauguration of Bhopal Chapter alongside a one-day workshop on failure analysis, jointly with Institution of Engineers (India). It is heartening to note that very good efforts are ON by our dedicated team members from GTRE, HAL, NAL and CEMEILAC to conduct the National Conference on Failure Analysis (NCFA 2020) in Bengaluru, subsequent to the decision in the Executive Council meeting. We need to intensify our efforts to enhance participation from industry and academic institutes in our events.

With more technical events coming up in the next 6 months, I am sure that our members would get several occasions to know the latest state-of-art developments and advancements in the domain of failure analysis and to establish new contacts.

Best wishes to all the readers!

B P C Rao
PRESIDENT, SFA



Dr. B P C Rao
President, SFA

Experts and experiences:

- S Dhanasekaran and Dr.M.Satya Prasad, Ashok Leyland, Chennai



From the Desk of Editors

Dear Readers:

Happy New year 2020! Season's Greetings! You are glancing through the 22nd issue of the Newsletter of Society for Failure Analysis (SFA).

SFA Activities are progressing satisfactorily during the past one year with the conduct of events by the chapters located at various locations. We had new Chapter initiated at Bhopal, thanks to efforts taken by our colleagues at BHEL and the academic institution, MANIT at Bhopal.

Chennai Chapter conducted the event, Clinic on Failure Analysis (CFA 2019) which is the third in the series since its start during 2011.

SFA newsletters were released every four months during last year.

For the present issue, we solicited articles experts of our country who had worked on many case histories and domain areas of relevance to improved efficiency and energy saving which is again an indirect way of prevention of failures or extension of life of components. In this respect, light weighting is important considering the fact that if you're designing rockets, the lighter you make it, the more payload capacity you can take. Similarly, if you are building an aircraft or automobile,

less weight would offer better fuel efficiency. For every 1 kg of mass reduction from an aircraft, a fuel saving of 100 kg is possible. We thank the author (Dr.M.Sathya Prakash, Ashok Leyland) for his contribution on "light weighting" which you would find quite interesting to read.

We take this opportunity to appeal to the Indian industry to use SFA as a forum to share their experiences on trouble shooting. A great way to add content to this newsletter is to include a calendar of upcoming events. The details of important forthcoming international and national events are included; so also the books recently published on the topics of the subject.

We value your comments, which really boost our enthusiasm to perform better. Therefore, as always, your views and comments, mailed to param@igcar.gov.in are welcome. We wish you all success free of failures and a joyful life!

You may visit our web site for your comments/suggestions or any queries: www.sfaindia.org

Kalpakkam

31-01-2020 (P.Parameswaran
Swati Biswas)
Editors

*We encourage you to join the society, Kindly fill up the application form (enclosed at the end of the newsletter) and contact secretary: param@igcar.gov.in; alternatively, post your application with draft to Sri.B Jana, Treasurer, **RCMA**, CEMILAC, Kanchanbagh, Hyderabad, 500 058*



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Editors of Newsletter:

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 Dr. Swati Biswas, GTRE

Aims and Objectives of Society for Failure Analysis

The aims and objectives of the Society shall be:

To serve as National Society to promote, encourage and develop the growth of "Art and Science of Failure Analysis" and to stimulate interest in compilation of a database, for effective identification of root causes of failures and their prevention thereof.

To serve as a common forum for individuals, institutions, organizations and Industries interested in the above.

To disseminate information concerning developments both in India and abroad in the related fields.

To organize lectures, discussions, conferences, seminars, colloquia, courses related to failure analysis and to provide a valuable feed back on failure analysis covering design, materials, maintenance and manufacturing deficiencies / limitations.

To train personnel in investigation on failures of engineering components and their mitigation.

To identify and recommend areas for research and development work in the Country relating to failure analysis.

To establish liaison with Government, individuals, institutions and commercial bodies on failure analysis, methodologies and to advise on request.

To cooperate with other professional bodies having similar objectives.

To affiliate itself to appropriate international organization(s), for the promotion of common objectives and to represent them in India.

To organize regional chapters in different parts of the country as and when the need arises.

To do all such other acts as the Society may think necessary, incidental or conducive to the attainment of the aims and objectives of the Society.





‘Understanding Failures in Engineering Materials ‘ (UFEM2019)

At Tyagarajar College of Engineering, Madurai during 7-9th Nov.2019

Society for Failure Analysis (SFA), Chennai Chapter organized “Understanding Failures in Engineering Materials”, (UFEM 2019) in association with Thiagarajar College of Engineering, Madurai during 7th-9th Nov 2019. The inaugural ceremony of the workshop was presided over by Dr.M.Palaninatha Raja, Principal-in-charge and Dean, Planning & Development, Thiagarajar College of Engineering, Madurai. Prof. Raghu Prakash, Department of Mechanical Engineering, Indian Institute of Technology, Madras was the chief guest of the program. Prof.R.Vasuki, Head, Department of Physics welcomed the esteemed gathering and Dr.V. Gayathri, Associate Professor, Department of Physics, Convener of the workshop UFEM2019 gave an overview on the proposed technical sessions during the workshop. Speaking on the importance of the topics of the program, Dr Palaninatha Raja stressed the need for such workshop as several novel materials are emerging due to extensive materials research and its proposed scientific & technical applications in various fields of engineering.

In the first session of Day one, Prof.Raghu Prakash delivered a lecture on Failure Analysis and Fracture Mechanics and discussed about the effect of the flaws in material. The second session started with interesting and informative lecture by senior corrosion expert Dr.Elyaperumal a leading Industry consultant. He presented on mechanically and environmentally induced fractures of process equipments in chemical

process industries with real time case studies.

On Day 2, First session, corrosion expert Dr.Elyaperumal continued his lecture on Real Time Case Studies on the Environmentally Induced Fractures of various types of Equipments in Chemical industries. Second session started with presentation by Mr.P.Sukumar Former Technician, IGCAR, Kalpakkam on the material preparation. He explained how the defect can be identified and the way to select the methods of recording the extent and size of the defects in different materials samples.

In the afternoon, Mr.N.Raghu, Head, Quality Assurance & Non Destructive Testing Section, Quality Assurance Division, IGCAR, Kalpakkam gave an extensive presentation on widely used NDT methods -its merits and limitations. The importance of selection of NDT methods for a specific case was highlighted by him.

For the second session in the afternoon, participants were taken to the Physics department of the Institution. Faculties of Physics department gave a presentation of various research faculties in the Materials Research lab and Nanomaterials Research lab . Later Mr.Sukumar of IGCAR gave a detailed demonstration of the surface preparation of the samples and explained the step by step procedure for the determination of the defects. He also illustrated to view the presence of flaws in microscope.

The third day had two sessions in parallel- one on Students’ awareness program and the other one





for the regular delegates. Dr. Parameswaran Head, XRDSES, Physical metallurgy Division, Metallurgy & Materials Group, IGCAR, Kalpakkam delivered a lecture for creating awareness among the young school students on the importance of the quality of the materials. He covered on the materials selection for different engineering application, techniques of characterisation adopted for checking the quality through microscopy methods, mechanical testing like hardness, performance assessment and related terminologies like wear, corrosion etc.

In the parallel session, Invited speaker Dr. N. Murugan, Professor of Robotics and Automation Engineering, PSG College of Technology, Coimbatore presented a lecture on “Failures in welds”. He highlighted through a number of case studies how the flaws originate in welds and how to mitigate them by suitable processing parameters.

In the afternoon session, the

participants visited composite materials lab and Heat transfer lab of Mechanical Engineering department to understand the working mechanism of sophisticated equipments and its usage. Faculties of the Mechanical department gave a demo of the flaw determination through ultrasonic flaw detector.

Dr. Parameswaran conducted a quiz program for the school students on the subject: “Failure analysis” where the students enthusiastically participated and based on the performance of the students 1 prize was awarded to Ms. Yohitha and Ms. Ruthralekha, class X1 students of Kendriya Vidyalaya, Madurai. Mr. Deepashree and Mr. Alert Justin of Class X1 students of the same school got the second prize.

In the valedictory function Dr. Elyaperumal presided over the function. Dr. P. Parameswaran distributed the certificates to the participants and Dr. Elayaperumal gave the prizes to the winning students. Dr. A. L. Subramanian, Assistant Professor, Department of Physics, Coordinator of UFEM2019 proposed the vote of thanks.



- ❖ Group photo of the inaugural day
- ❖ Group photo on the final day
- ❖ Awareness program on Failure analysis for plus 2 students





Weight Reduction Initiatives in Indian Product Development Scenario

S Dhanasekaran and M Sathya Prasad

- Ashok Leyland Limited

Need to reduce weight

As there is a significant stress on greenhouse gas reductions and improving fuel efficiency in the transportation sector, all automakers, suppliers, assemblers, and component manufactures are investing heavily in lightweight materials R&D and commercialization. One of the major setbacks in the use of lightweight materials is their higher cost and research is directed towards reducing costs through development of new materials, forming technologies, and manufacturing processes.

Reduction of vehicle weight leads to reduced fuel consumption or higher payload capacity for the customer. For example, weight reduction of 100kg in BMW vehicles resulted in fuel savings (Gasoline-0.34 to 0.48 litres and Diesel-0.29 to 0.33 litres) in a stretch of 100 km in New European Drive Cycle (NEDC) [1]. A general thumb rule says that 10% reduction in vehicle weight gives 7% fuel economy in a heavy vehicle. This also means that for every kilogram of weight reduced in a vehicle, there is about 20 kg of carbon dioxide reduction. The secondary benefits of light weighting include reduction of exhaust emissions to conform to the existing emission norms in the specific regions. It also may have an impact on better road life. For achieving light weight solutions in automobiles, R&D on light weighting has to go through the stages of concept feasibility, technical feasibility and demonstration feasibility.

Methods to reduce weight

Weight can be reduced either by direct substitution of the existing material with an alternate one or modification of the design or combination of both. The alternate materials generally used for weight reduction are aluminum, magnesium, and

titanium; advanced engineered materials, such as metal matrix composites (MMCs) and ultralight materials (e.g., engineered laminate materials and foams); materials that enable light-weighting, such as advanced high-strength steels or stainless steels; reinforced polymer composites (reinforced with glass fiber, carbon fiber, combinations of glass and carbon fiber, other advanced fibers, and nanoparticles); and unreinforced polymers. These materials must be strategically applied to optimally match their special properties to key application needs.

The alternate material in general could work out cheaper by virtue of availability or easier manufacturability. For instance, austempered ductile iron (ADI) as a potential replacement for forgings looks promising. ADI has mechanical properties as good as forgings and can be cast into near net shape. This advantage helps the designer to arrive at complicated optimized designs that would not have been possible using forgings. Likewise, magnesium alloys, despite being expensive on a per kilogram basis, offer superior strength to weight ratios and therefore find increasing applications in automobiles.

Intelligent material replacement is only just one half of the story. With increasing sophistication of computer aided engineering software, it is now possible to arrive at designs that are highly optimal. Minimum weight design also has a number of other advantages. In automotive suspension design, for instance, lower unsprung mass results in better ride comfort due to reduced inertial forces. An optimized component has strength uniformly distributed and offers better meaning for the term "factor of safety." In other words, a design that is not optimized can have





Japan's humid and warm summer climate, as well as frequent earthquakes resulted in lightweight timber buildings raised off the ground that are resistant to earth tremors.

Harry Seidler

regions of extreme strength and weakness. The vulnerable regions have a higher chance of failure in a catastrophic event. A good design is one that is capable of providing assurance that the factor of safety can be applied to the Methods to reduce weight

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better ride comfort due to reduced inertial forces. An optimized component has strength uniformly distributed and offers better meaning for the term "factor of safety." In other words, a design that is not optimized can have regions of extreme strength and weakness. The vulnerable regions have a higher chance of failure in a catastrophic event. A good design is one that is capable of providing assurance that the factor of safety can be applied to the entire component and not just the highly stressed region. Minimum weight designs, by virtue of removing the so-called fuses (or weakest regions of a structure), reduce the peak stresses. This, evidently, leads to better fatigue life. Environmental effects such as stress-corrosion cracking are also minimized in an optimized part. Sharp geometric changes in design can lead to deformation-controlled stresses because of stress discontinuity. Such secondary contaminations are reduced during optimization. In view of all these advantages, it only makes sense to include shape optimization as part of routine design process. State-of-art optimization analyses coupled with intelligent material selection is the best method to address weight reduction in a wholesome manner. This article is to look at weight reduction from purely a materials stand-point, with an understanding that use of state-of-art structural simulation tools is becoming somewhat commonplace.

Advances in Light weight Materials Technology in the World

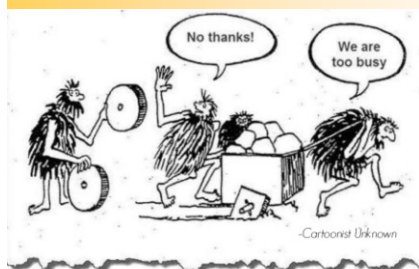
In the last decade, industries across the world have taken a giant leap towards the use of alternate light weight materials for reducing the mass of their products especially in the transport sector. The use of high strength steels and aluminium for light weighting the vehicle has been an important highlight.

The aluminium usage for light weighting the passenger cars in North America alone has increased from 75 pounds to 250 pounds per vehicle (Ducker Research). Ford uses more than 40 million pounds of aluminium sheets per annum for their car models such





as Lincoln, Ranger, F Series and Expedition. 5XXX series are mostly used with good economical advantage. They use at least 700 pounds per vehicle with annual production of 4 million vehicles in USA and more than 7 million world wide. Most of them go to BIW, closure, deck lid and body castings. The weight savings achieved in light material such as aluminium is of the order of 40% [2], but the raw material cost is more than thrice that of conventional steel. The manufacturing cost is also higher. Hence, adoption of light metals is fraught with higher costs. In addition, light metals also have lower modulus which warrants use of higher wall thicknesses. This limits use of such components where additional packaging space is available for fitment. In addition, there are issues in joining and forming which further increases cost and manufacturability concerns.



Advanced high strength steels (AHSS) enable light weighting of automotive due to reduction in thickness associated with enhanced mechanical strength. It has been estimated that the weight reduction is as high as 15% when these steels are used. Several manufacturability issues in forming, joining etc have been overcome [3]. The cost of material is not as significantly high as that of light metals and hence these are being pursued for several applications. The steels that belong to this class of AHSS are Dual Phase (DP) steels, Complex phase (CP) steels, transformation induced plasticity steels (TRIP) steels, twin induced plasticity (TWIP) steels, martensitic steels etc [4-5]. They are distinctly different from traditionally used low carbon steels in that they have high plasticity to enable metal forming operations such as stampings along with good mechanical strength. It has been estimated that contribution to the body closure in an automobile accounts for about 50% of the weight of an automobile [4]. Hence, usage of AHSS is preferred over other commercial steels.

Austempered ductile iron (ADI) is finding an ever-increasing worldwide market in the automotive and other sectors. It offers a range of mechanical properties equal to the forged steels and offer excellent economic competitiveness with forged steels. ADI is a

heat-treated form of as-cast ductile iron. The heat treat process, improves the strength and toughness of ferrous alloys. Ductile iron, with its relative low cost and ease to manufacture, has been one of the largest beneficiaries of the austempering process. Austempering is a high-performance heat treatment for ferrous alloys which produces an engineered, tailorable matrix structure. This austempered matrix structure gives tensile strength, toughness, impact strength and fatigue properties that are comparable to heat-treated steels. The ADI casting requires a precisely controlled heat-treatment to develop the desired microstructure (acicular ferrite and carbon-stabilized austenite) and mechanical properties.

Advantage of ADI compared to steel:

- Near net shape casting
- Strength Comparable to steels
- Lower density than steel
- Excellent fatigue strength
- Superior wear & abrasion resistance (Work hardens when stressed)
- Improved vibration & noise damping (Presence of Graphite)
- Flexibility to designer to attempt complex

The use of Mg alloys to reduce the mass of automotive components has grown rapidly. Parts include instrument panels, cross-car beams, seat frames, steering wheels, intake manifolds, valve covers, transfer cases, numerous small brackets and, most recently, the Mg engine cradle for the Z06 Corvette. In Europe, Mercedes-Benz has introduced an automatic transmission case and BMW has introduced a unique, inline, 6-cylinder engine. The BMW "composite" engine comprises an Al-alloy inner casting around which is a cast Mg shell. The Al "inner" provides the performance requirements. The use of Mg automotive components in new-vehicle applications can be utilized to reduce vehicle weight and improve performance. Mg sheet and wrought technologies hold potential for vehicle application, but application is long-term due to limitations on manufacturing





If I say 'Find me an interesting painting' to Google, someday a robot could go around the Picasso museum and take a picture for me.

Vijay Kumar

process. Perhaps the quickest near-term path to increased Mg content in automobiles is through increased use of metal castings. Wider vehicle application of cast Mg components offers a potential weight reduction of nearly 100 kg per vehicle. The Structural Cast Magnesium Development (SCMD) project has successfully demonstrated the re-design, conversion, and production of a production cast aluminum (Al) engine cradle to cast Mg, providing weight reduction of approximately 35%. Similar applications of Mg castings for suspension and chassis components can be achieved. To produce affordable, high-strength Mg castings, it will be necessary to develop and optimize Mg-casting procedures (existing and/or new) and to develop tools that support the casting process and reduce the cost of Mg components. Despite both advances in Mg manufacturing technologies and favorable material costs leading to generally increasing levels of use in automotive structures, widespread and expansive use of Mg alloys as a major automotive structural material in the same class as steel and aluminum (Al) is yet to be realized. This is, in part, due to fundamental physical properties of Mg castings, which are the predominant form of usage, particularly with regard to deformation and fracture behaviors. Furthermore, technologies which permit the manufacture of extended structures by joining of individually formed components are not well-developed for this material. Nevertheless, as a structural material, with high strength-to-weight values approaching or exceeding that of Al, Mg offers an attractive approach for achieving the Freedom CAR's materials goals of up to 50% weight reduction in comparison to steel alternatives, with cost, reliability and recyclability attributes that are comparable or better than other structural materials of consideration for these tasks [6]. Magnesium Front End Research and Development (MFERD) brings together a unique team of international scope – i.e., Canada, China and the United States – to explore certain “enabling” technologies which could, if successful, permit the integration of Mg-based subsystems into optimized assemblies for

vehicle body structure applications using the “front end” structures as a test bed, thereby permitting exceptional levels of overall vehicle weight reduction and handling attributes supporting the Freedom CAR initiative.

Although Ti is light and strong, its role in the automobile has been almost nonexistent because of its exorbitant price. This high price is a direct result of the current Kroll production route which is time-consuming; energy-, capital- and labor-intensive; and batch-based. However, new technologies are emerging that may change the characteristics of the Ti market. In particular, these technologies may reduce the Ti price sufficiently to allow it to compete in high volume markets, possibly even automotive. This project examines the P/M behavior of Ti powder produced by a new process developed by ITP. The production of low-cost Ti for automotive applications will require cost reductions in both raw materials and secondary processing operations. The approach to this project will be to evaluate the suitability of emerging Ti beneficial technologies for the production of low-cost automotive components. The ITP powder process produces an alloy powder with morphology very similar to other emerging technologies such as FFC Cambridge and MER anodic reduction. Because ITP can produce powders in sufficient quantity for evaluation, the ITP process will be used as the basis for the evaluation.

Plastics and rubber offer considerable potential in the field of lightweight construction, not only because of their low density compared with their metal and ceramic counterparts (i.e. weight saving attributable to the material), they also offer considerable flexibility in processing and design (i.e. weight saving attributable to design and/or production). While rigid, plastics and rubber are predominantly used for sport and leisure articles, cellular plastics and rubber are particularly suitable for packaging, building and transportation because of their good energy absorption and insulation properties, combined with





the additional weight saving. Epoxy resin foam for weight-savings in auto construction and for reinforcing the bodywork at critical points to increase accident safety by absorbing impact energy. Plastic oil sump module made of polyamide was used for the first production-line. Torque roll restrictor for the Porsche Panamera consists of a high-strength polyamide with function-optimised rubber compound. The new Artega GT sports car is the first production-line vehicle to have a body made completely of polyurethane.

Emerging Materials and Manufacturing Processes - "Emerging materials" are seen as including novel structural materials and concepts not included in the primary categories of conventional structural materials for automotive manufacture. These materials would include (but are not limited to) structural foams and adhesives (both metal and polymeric), synthetic materials (incorporating space-filling, but lightweight particles), nanocomposites, micro-tailored structures (so-called 'geodesic' materials), bio-mimetic materials, renewable-resource biomaterials, as well as new states of matter which might be identified for structural purposes. Similarly, emerging manufacturing processes might include methods of fabricating unique hybrid structures (e.g. metal/polymer composites) or altogether new means for extending the structural utility of existing materials (e.g. origami or folding processes for metals, selective structural strengthening by local heat treatments, ribbed or gusseted structural features, etc.). Novel manufacturing processes may also include special methods of joining dissimilar materials (e.g. adhesive bonding) or non-destructive test methods. It is expected that new initiatives may be introduced in this broad and growing field. The strategy in this case is to review each proposed topic on a case-by-case basis for assessment of its overall potential to meet program goals for weight reduction, affordability and recyclability.

Principles barriers to overcome for light weighting programs

Cost: The current cost of light weighting materials (compared with plain carbon steel and cast iron) impedes their widespread use in structural applications.

Design and simulation technologies: Adequate design data (e.g., materials property databases), test methodologies, analytical simulation tools, and durability data do not exist for many lightweight materials and manufacturing technologies. Current manufacturing processes for lightweight materials lack design flexibility and do not optimize the use of the materials for structures.

Hybrid Materials and Structures: Hybrid materials and structures that use the optimum material for each application are not feasible with the current design and manufacturing knowledge base.

Manufacturability: Methods for the cost-competitive production of components for heavy vehicles are not sufficiently well developed. They also must be made compatible with manufacturing procedures and volumes.

Tooling and prototyping: The cost of tooling for forming components made with lightweight materials is too high for the volumes. The development and fabrication time required for prototyping components is too long.

Joining and assembly: High-yield, robust joining technologies for lightweight materials are not sufficiently developed. Assembly and joining techniques for dissimilar materials and hybrid structures are inadequate.

Corrosion: Many lightweight materials and light weighting approaches cannot be used in commercial vehicles because of significant corrosion and maintenance issues. Corrosion is a significant contributor to the cost of maintenance. Research is needed to develop materials that are resistant to both general and galvanic corrosion. Low-cost, durable coatings are needed.

Maintenance, repair, and recycling: Technologies for cost-effective





Nothing is more fatal to the progress of the human mind as to suppose that our views of science are ultimate, that there are no mysteries in nature; that our triumphs are complete, and that there are no new worlds to conquer-

Humphrey Davy

maintenance and repair are inadequate for many lightweight materials. Recycling methods for lightweight materials are not as well developed as those for ferrous materials. Infrastructure and markets for efficient use of recycled composites are inadequate. Damage resistance and tolerance are not well developed for many lightweight materials.

Approaches to overcome the barriers

There are several approaches to overcome these barriers. The following lists a few of them taking the example of a commercial vehicle industry.

- Development of technologies for enhanced manufacturability of lightweight components
- The introduction of lower cost carbon fiber and hybrid composite materials
- Lower-cost tooling and assembly technologies to reduce component part count and resulting tooling cost
- Adapting established heavy vehicle materials and manufacturing technologies, such as Sheet Molding Compound and compression molding to lighter weight carbon fiber and hybrid composite materials.
- Development of design concepts and material data bases to provide design engineers the flexibility to consider lightweight materials in vehicle design.
- Development of technology in support of advanced materials, joining, maintenance, and repair.

For example in a heavy duty commercial vehicle, the greatest weight reductions are foreseen through the use of high-strength steel, aluminum alloys, and polymer matrix composites in frames and bodies and, in lesser quantities, in wheels, cabs, transmission housings and shafts, and suspension components. Ultra large, thin-wall aluminum and steel castings, superplastic forming of aluminum, and integrated composite manufacturing technologies will reduce part count and thereby weight and cost. Hybrid composite materials that utilize lower-cost glass fiber and core materials in

combination with carbon fiber reinforcements can meet structural requirements while reducing the amount of more expensive carbon fiber. Other weight reduction opportunities include stainless steel in frames, reinforced aluminum blocks in light-duty engines; sandwich, cored, and foam materials.

Need for development of India specific weight reduction solutions

Although steel has been the material of choice for many automotive components since the dawn of the automotive age, there is evidence that a change to lightweight intensive materials would bring significant environmental and economic benefits. India faces stiff competition from established automakers in Germany, the United States, Japan, and even China. These countries have mastered advanced aspects of vehicle technology, made improvements in the power train, and, in some cases, tackled low cost manufacturing. They do not leave India with many areas to carve out a niche. In India, the automotive industry is just gearing up and there is a steep learning curve to produce light weighting, but it is a long-lasting asset. India could also export vehicles to developed markets, since light weighting will help meet fuel efficiency mandates (like CAFÉ standards) and reduce dependence on foreign petroleum. It is estimated that lightweight vehicles consume about 2/3 the fuel of conventional (steel) vehicles.

Implications of Weight Reduction in Indian Industries

Global fuel demand and fuel prices are likely to remain on an upward trend despite severe volatility. Heavy vehicles consume much fuel. As the vehicle population of India rises, a lightweight fleet will reduce total national fuel needs (Rough estimate: \$24B/year by 2035). The world's largest, established auto companies of Europe, North America, and Asia have already made much investment in heavy, steel-based vehicles that they cannot easily lead the way to ultra-lightweight vehicles. The Indian auto industry is in the early stage of significant growth and it will not be too late to plot a different course.





Technologically, there is still much R&D to be done and followers will not be able to copy so quickly. Technology licensing royalties is very much possible. Vehicle light weighting requires a redesign of the entire automotive supply chain. Established industries in other countries will not easily do this. Since India's auto supply chain is still young, it is easier to mould from the beginning. As fuel prices rise, demand for lightweight vehicles will also rise. If Indian automobiles are the lightweight leaders, Indian vehicles and Indian technology will be in high demand around the world.

Light-weighting strategies of Indian automakers and Tier-1 companies

Light weighting is also considered an important objective by all of the prominent Indian automobile manufacturers. In the recent past, Tata Motors has used alternate materials such as high strength steels, aluminum alloys and plastic composites for light weighting. Going forward, it is exploring several new measures including hollow construction using high-strength tubes and hot stamped parts, greater harnessing of light weighting potential of aluminum and its MMC as well as plastic composites and nanoclay plastic composites. Tata says that going forward; the cost of materials like magnesium, titanium and carbon fibre composites will reach levels where their light weighting potential can be put to use economically. Vehicles of the future will be of multimaterial construction, where each material performs several roles in addition to offering light weighting advantage.

GM India is evaluating alternate lightweight materials for various applications in its vehicles. Many of its new products in the US, for example, use aluminum for the bonnets and rear tailgate. Its R&D facilities are developing parts that are expected to be much lighter than existing products. GM also uses state-of-the-art simulation tools early in the design phase to reduce and optimize weight. With increasing application of plastics, SMC, magnesium and aluminum, GM hopes to develop lighter vehicles in the future as technologies evolve.

Honda Siel Cars India uses high-tensile steel in

the manufacturing of its cars for lightweight yet high strength and enhanced safety. Also, high-quality materials like magnesium, aluminium and high-quality plastic are used to ensure that its vehicles are not heavy. HSCI has also restricted the use of hazardous materials such as asbestos, chrome6, lead, cadmium and mercury to ensure its vehicles are safe and ecofriendly.

The commercial vehicle manufacturer like Volvo – Eicher JV has used materials like composites, aluminum and high strength low alloy steels coupled with extensive weight optimization techniques that have helped it to continue making lighter vehicles, thereby enabling customers to carry more payload for the same gross vehicle weight.

Yamaha Motors India has taken to lightweight its vehicles which include re-engineering of parts and careful selection of materials that help it improve the power-to-mass ratio. Going forward, India Yamaha says it is focusing on re-engineering of parts and taking other weight reduction measures such as using superior raw material and increasing the number of plastic parts.

Mumbai-based Mutual Industries designs and manufactures parts using low-weight plastics. As automotive plastics specialists, the company believes that there are many more potential applications than the established ones that could contribute towards light weighting. While a range of polypropylenes and ASA have been used in manufacturing automotive exteriors and interiors as painted or textured fascias and trim to substitute pressed sheet-metals, polyamides and acetals have been substituted for cast metals for weight and noise reduction. The material properties in each family of plastics can be tuned into the composition to cater to the specific requirement of the part and its structure.

Zoom Automotive tied up with YAPP Automotive Parts Company of China for





technical assistance to make plastic fuel tanks. To make these plastic tanks, it has been using HDPE sourced from Basel, Korea. The Figo, Ford's small car offering for India, also has a Zoom-made plastic fuel tank.

Infrastructure and resources required for a cross-functional effort

In India, currently there is a need to focus upon bridging the R&D efforts of industries and research institutes. Facilities for lab scale analysis on fundamentals of materials and testing can be very much availed in some of the prestigious research institutes across the nation while the component or aggregate level testing will have to be done at the technical centres of the specific industry. Proposed Light-weighting materials, strategy and goals :

Advanced high strength steel

Strategic Framework

High strength steel can replace conventional steel to achieve mass reduction on a component by 30%. The weight savings of 15% for a total body structure can be achieved. Significant changes in the vehicle body architecture, which may deviate from the current proven methods, may be required.

Relative cost per part Vs conventional steel is 1 to 1.5 times

Research objectives

Long-term goal (5 to 10+ Years)

Enabling the use of advanced steels to develop components that can give a weight reduction of 20 to 35% on a component level and achieving up to 15% lighter body structure and cost parity with incumbent materials.

Intermediate goals (3-5 years)

Enabling the use of advanced steels to create components and structures with 15- 25% wt reduction and systems cost of \$0.50/kg (\$0.25/lb) saved, without significant changes to currently proven manufacturing processes. Developing improved alloys with higher strength, better formability, improved structural and crash performance.

Immediate goals (< 3 years)

Achieving sheet material cost reduction to

further reduce the cost of steel components and structures.

Developing an improved understanding of the automotive manufacturability and performance of advanced high strength steel components.

Aluminum

Strategic Framework

Aluminum structures and components can be designed to replace steel and cast iron parts to achieve mass reductions of 40 - 60%.

Relative cost per part vs. traditional materials 1.3- 2.0 times

Research objectives

Long term goals

Enabling the use of aluminum to create component and structures with 40-60 % wt reduction and system cost parity with incumbent materials

Intermediate goals

Developing low cost aluminium alloy with better formability and this is capable of (40-60%) weight reduction of component and structures.

Identifying/Developing cost effective high volume manufacturing and joining process of aluminium alloys

Developing recycling to optimise scarp value

Immediate goals

Identifying the potential, existing steel /cast iron components that can be replaced with aluminium alloys.

Developing design procedures (including CAE techniques) for replacing existing components with aluminium alloys.

Polymer composites

Strategic Framework

Carbon/Glass fiber reinforced polymers developed to replace steel parts will achieve mass reduction of 50 -60%

Relative cost per part vs. steel 2 to 10 times

Research objectives

Long term goals





Enabling the use of carbon FRP to create structures, relative to incumbent material, with 55-65% wt reduction and cost parity.

Intermediate goals

Developing low cost carbon fibers for reinforcement in polymer composites and guiding suppliers in developing carbon fibre materials to suit automotive requirements.

Developing methodology for recycling of polymer composites

Evaluating viable new moulding processes

Immediate goals

Identification of structural/ non structural components that can be replaced with polymer composites.

Magnesium alloys

Strategic Framework

Magnesium components are envisioned to replace an equivalent volume of ferrous material with a reduction of 70 - 75%, and aluminum with a reduction of 25- 35%.

The relative cost per part for replacement of steel is 1.5- 2.5X and 1.0 -1.5 for replacement of aluminum

Research objectives

Long term goals

Enable the use of Magnesium to create closures and large semi-structural and power train components with 60-75% wt reduction (Fe -based materials) or 20-30% (Al-based materials) and systems cost parity with incumbent materials.

Intermediate goals

Achieving feedstock cost reduction so as to enable overall cost parity with incumbent materials.

Developing improved high-volume manufacturing techniques for shaping (casting, forming, etc.) and joining (welding, bonding, etc.).

Developing recycling to optimize scrap value.

Developing corrosion protection technology.

Immediate goals

Fundamental studies of Mg (deformation, corrosion, creep behavior, impact, etc.)

Developing of Low pressure casting, warm forming of Mg sheet, Low-cost Mg sheets

Recycling of prompt scrap, especially for creep

resistant alloys

Titanium

Strategic Framework

Titanium developed to replace alloy steels and stainless-steel parts can achieve a mass reduction of 40- 55%.

The relative cost per part vs. steel is 1.5-10X.

Research objectives

Long term goals

Using titanium in specific components and structures to achieve 55% weight reduction with cost parity to competing materials

Intermediate goals

Developing and validating low- cost Ti extraction and conversion technologies

Developing low-cost technologies for melting and processing Ti into mill products

Improving technologies for component manufacturing, including forming and machining

Immediate goals

Developing low-cost powder metallurgy processing techniques for net-shape manufacturing

Developing new Ti alloys specific to automotive and powertrain applications.

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2. Andrew M. Sherman "Trends in Automotive Applications for Aluminum", 7th International Conference on Aluminum Alloys, Virginia, 2000
3. Advanced high strength steel (AHSS) application guidelines, International Iron & Steel Institute, Committee on Automotive Applications, 2005
4. Automotive Steel Design Manual, American Iron and Steel Institute and Auto/Steel Partnership, 2002
5. Introduction to Advanced High Strength Steels, Part I: Grade Overview -By Daniel J. Schaeffler, Ph.D., The Fabricator, August 9, 2005, (http://www.thefabricator.com/MetalsMaterials/MetalsMaterials_Article.cfm?ID=1139)
6. Freedom CAR and Fuel Partnership, Materials Technology Roadmap, 2006





Inauguration of Bhopal Chapter

Society for Failure Analysis initiated efforts to inaugurate the Bhopal Chapter with the aim of catering to those in the region. Mr Neeraj Dave, Chairman, IEI, M.P.S.C, Bhopal joined the inauguration function and spoke on the importance of engineering failure analysis. Dr.B P C Rao, President SFA presided over the function and appreciated the efforts of organisers to bring interested people which include engineers working in BHEL, academia from MANIT and scholars of local engineering colleges. He expressed happiness that on a day which is incidentally Sunday, there were more than 50 participants. Encouraging all the participants, he declared open Bhopal Chapter. Further, the inaugural function also honoured local faculties and employees of BHEL who have contributed in an enriching manner to failure analysis during their career. A half day workshop consisting of expert lectures

followed then.

The function ended with vote of thanks by Dr. Jogindranath Sahu, convener of the event who expressed all his colleagues who stood in support at various levels during the organisation of the event with a special mention to the following:

Dr. Bharat Kr. Modhera, Hon. Sec., IEI, M.P.S.C,

Dr C Sasikumar, MANIT Bhopal
Dr Ramesh Kr.Nayak, MANIT Bhopal,
Shri Vivek Gupta, BHEL,
Shri Sachin Bhartiya , BHEL,
Shri Yogesh p. Hinge, BHEL,
Shri Pradyumn, BHEL,
Shri K. Shitij Shrivastava, BHEL,
Shri Rahul Buswale, BHEL,
Shri Palhabit Dube.



Group Photo taken during the Inauguration of Bhopal Chapter





Clinic on Failure Analysis –CFA 2019
at Anna University, Chennai

Clinic on Failure Analysis (CFA-2019) was conducted at Anna University, Guindy, Chennai during 13-14 December 2019. The clinic was inaugurated by Prof.M.K.Surappa, Vice Chancellor, Anna University, Chennai as the Chief guest of the function. Dr B P C Rao, President, SFA and Outstanding Scientist and Project Director, FRFCF, IGCAR, Kalpakkam presided over the function. Welcoming the delegates, Prof. Raghu V Prakash, Chairman, SFA, Chennai Chapter spoke briefly about the activities of SFA, Chennai Chapter and in particular mentioning the importance of series event CFA which is being conducted for the third time since it was started in 2011. Presiding over the function and speaking on the occasion, Dr.B.P.C.Rao, President, SFA addressed the delegates on the importance of the domain area and the mission of SFA to reach out engineers and impress on the various issues generally observed in engineering enterprises which may range from procurement of right quality raw material to production of various components, their certification and assuring their performance. The guest of Honour Prof.P.Chellapandi, INAE Distinguished Professor, IIT Madras and former CMD, Bhavini, Kalpakkam expressed his appreciation for the organisers to bring out a useful workshop for the youngsters. Addressing the delegates who were mainly young scholars, Prof.M.K.Surappa spoke on the importance of the subject and how dear it is for the budding engineers who are likely to face challenges when they take up a career in engineering enterprises. He lauded the efforts SFA, Chennai Chapter which in coordination with local professional bodies of Anna University has made a fine useful program. The inaugural function ended with a vote of thanks by Sri.C.N.Venkiteswaran, Organising Secretary, SFA.

The two days event consisted of talks by experts in the morning and afternoon. On the first day the key note lecture was delivered by Prof P Chellapandi. Following

this, Dr.K.Elayaperumal brought the importance of environment in crack propagation in engineering components. A talk by Dr.Vishnuvardhan, Scientist, SERC, Chennai highlighted the importance of component level testing for assessment of fatigue endurance where his institute has built excellent facilities. The afternoon session had a talk on the systematics of how failure analysis of engineering components can be carried out by Sri C N Venkiteswaran, IGCAR, Kalpakkam. Following this, various material testing facilities marketed by M/S ABS, Chennai was presented by Sri. Anand Shankar and later the delegates were taken for a session on demo.

The second day consisted five talks and a session on demo. Starting the day with a lecture on NDT methods in failure analysis, Dr. Rajkumar, IGCAR brought out the important methods of NDT and how one can employ them to identify the flaws in components. The second lecture was presented by Dr.M.Sathya Prasad, M/s Ashok Leyland, Chennai in which the speaker emphasized the need for innovation in design methods by learning by intuition from nature and further stressed the need for avoiding provision of redundancy in design if it is not really useful. This was followed by a talk on failure analysis of engineering components by Sri Sivasubramanian of M/s.MTS, Chennai. Highlighting the importance of fractography, Mr.Fannish Tewari, M/s Caterpillar, Chennai presented a talk bringing out the various modes of failures and their identification. The importance of corrosion and monitoring systems was presented by Mr.Balasubramanian of M/s ipgi Instruments, Chennai. The afternoon session was again devoted for demo by Mr.P.Sukumar, formerly of IGCAR, Kalpakkam on specimen preparation methods for fractography and metallography from failed components.





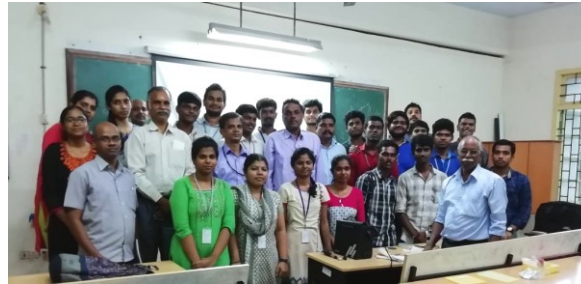
Inaugural function of CFA 2019:

Top left: Welcome by Prof Raghu V Prakash, Chairman, SFA, Chennai chapter;

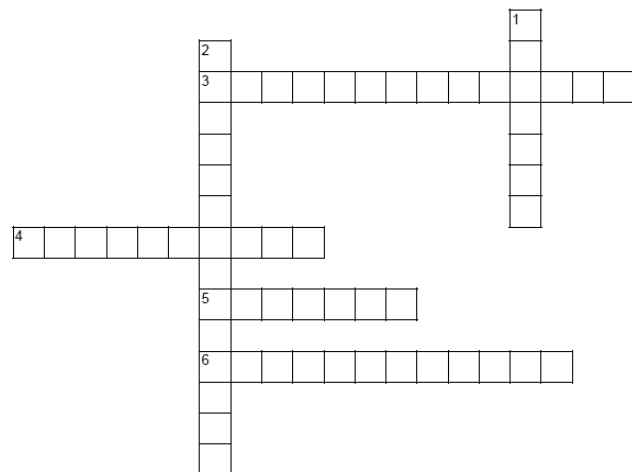
Top right: Presidential address by Dr.B.P.C Rao, President, SFA;

Left: Address by Chief Guest: Prof. M K Surappa, Vice chancellor, Anna Univ., Chennai;

Bottom: Group Photo of participants



Cross word puzzle involving terminology of structural failures



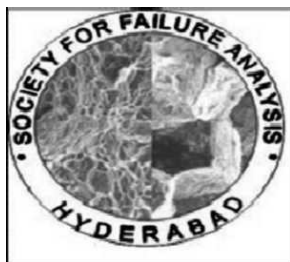
Across

- 3 soil losing compact nature
- 4 building rests on this
- 5 building rests on this will be stronger in earthquake
- 6 soil becoming loose during earthquake

Down

- 1 earthquake causes this to the building
- 2 proneness to earthquake

See page 20 for answers:



Society for Failure Analysis

Application Form

Society for Failure Analysis

C/O Centre for Military Airworthiness & certification, RCMA (Materials)
Hyderabad 550 058

Phone: 040-24340750; 24348377;

Fax : 040-24341827

E-mail: rdcma.mat@cemilac.drdo.in

Please ✓ applicable

member

☐

Life Member

☐

1. Name in Block Letters

First

Middle

Last

2. Date of birth

3. Father's Name/ Husband's Name

4. Present Occupation /Designation and office address:

Phone:

Mobile:

Fax:

Email:

5. Academic & Professional Qualifications:

6. Home address:

Phone:

Mobile:

Fax:

E-mail

6. Address for correspondence:

office ☐

Home ☐

7. Professional Experience:

8. Endorsement by SFA Member

Name	Membership No.	Signature

9. Primary Field of Interest: (please mark 1,2,3 in the in order of preference)

Strategic ☐	Power ☐	Foundry ☐	Welding ☐	Heavy industry ☐	transport ☐
Design & Failures ☐	Quality control ☐	Petrochemical ☐	Consultancy / services ☐	Materials and manufacturing ☐	Education ☐

10. Name of the Chapter you intend to be attached

(Please refer to Chapters' list)

11. Subscription details:

Payment should be made by cheque / DD favoring "Society for Failure Analysis", payable at Hyderabad. Outstation cheques not accepted.

Amount Rs. Cheque / D.D. No Dated

Bank Name Branch

Category	Amount Payable		
	Admission Fee (One time)	Yearly Subscription	Total on joining
Student Member	NIL	Rs 200	Rs.200/-
Life Member	NIL	Rs 2000	Rs.2000/-

12. Declaration by the applicant

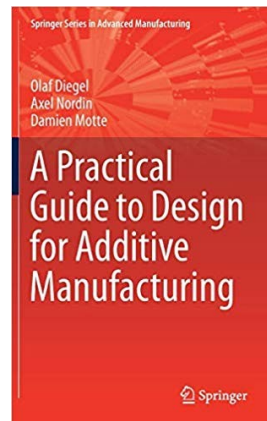
If elected, I agree to accept to pay the prescribed yearly subscription, to abide by the Articles of Association of the Society and to promote its aims and objects.

Signature of the Applicant

13.	Office Use Only				
	Membership No.		Date of Enrolment		Chapter
	Amount Paid (Rs)		Receipt No. / Date		

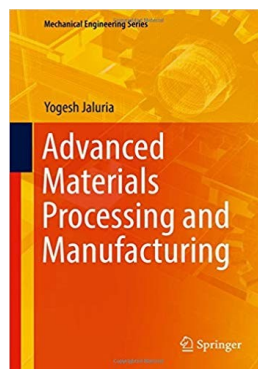


Books



. This book provides a wealth of practical guidance on how to design parts to gain the maximum benefit from what additive manufacturing (AM) can offer. It begins by describing the main AM technologies and their respective advantages and disadvantages. It then examines strategic considerations in the context of designing for additive manufacturing (DfAM), such as designing to avoid anisotropy, designing to minimize print time, and post-processing, before discussing the economics of AM.

The main benefit of the book is its highly practical approach: it provides directly applicable, “hands-on” information and insights to help readers adopt AM in their industry



This book focuses on advanced processing of new and emerging materials, and advanced manufacturing systems based on thermal transport and fluid flow. It examines recent areas of considerable growth in new and emerging manufacturing techniques and materials, such as fiber optics, manufacture of electronic components, polymeric and composite materials, alloys, microscale components, and new devices and applications. The book includes analysis, mathematical modeling, numerical simulation and experimental study of processes for prediction, design and optimization. It discusses the link between the characteristics of the final product and the basic transport mechanisms and provides a foundation for the study of a wide range of manufacturing processes.





Events in the pipeline

8th International Conference on Creep, Fatigue & Creep-Fatigue Interaction: 9-12 Feb, 2021, Hotel Radisson Blu Resort Temple Bay, Mamallapuram, Tamil Nadu

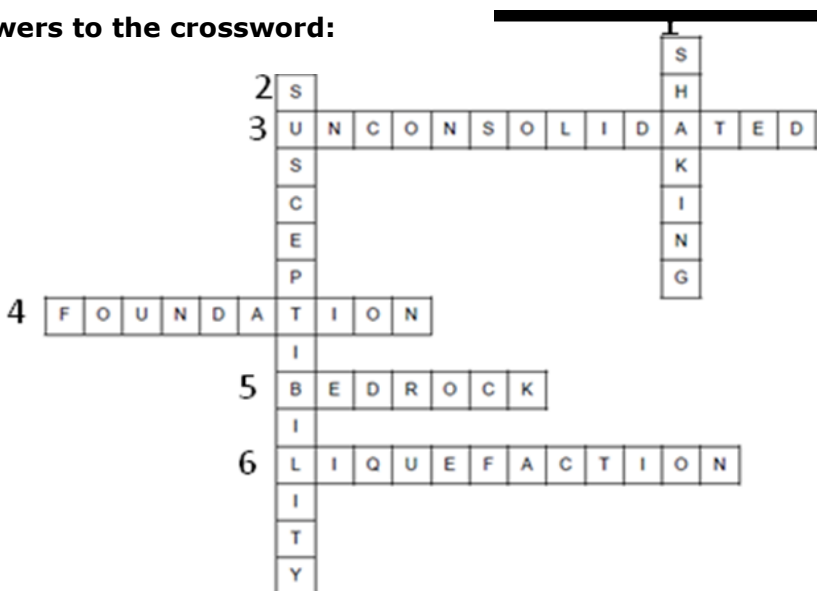
Scope of the Conference

The challenges involved in addressing the growing global energy demands with reduced greenhouse emissions have to be met by advanced fission and fusion nuclear reactor systems and fossil-fired ultra supercritical power plants, all of which involve complex technologies and operating environments that raise new challenges for materials development and understanding of their mechanical behaviour. Performance of materials under creep, fatigue and combined creep-fatigue loadings is of utmost concern in the design, operation and reliability of high temperature components.. CF-8 aims to bring together experts working in the areas of creep, fatigue and creep-fatigue interaction, development of high temperature creep and fatigue resistant materials and life assessment so as to facilitate mutual interaction and exchange of knowledge and experience.

World Summit on Materials Science and Nanotechnology, 26 March 2020 09:00 - 27 March 2020 18:00, Madrid, Spain

Materials Science 2020 aims to bring together all the Materials Scientists, Materials Engineers, Materials Researchers, Chemists, Research Scholars and Students from all over the world to share their knowledge. Materials Science 2019 provided a global platform to showcase and discuss recent innovations in the field of Materials Research and Nanotechnology. It also provides a great opportunity to network with peers, discover new products and services from vendors and sponsors and discover new solutions by interacting with peers physically.

Answers to the crossword:



Across

- 3 soil losing compact nature
- 4 building rests on this
- 5 building rests on this will be stronger in earthquake
- 6 soil becoming loose during earthquake

Down

- 1 earthquake causes this to the building
- 2 proneness to earthquake





July 9-11, 2020

National Conference on Failure Analysis (NCFA 2020)



**Organized by
Society for Failure Analysis
(Bengaluru Chapter)**



**Venue
HAL Convention Hall, Bengaluru,
India**

www.ncfa2020.com

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Member	Ms Vaishakhi S Nandi
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NCFA 2020

Pre-conference workshop

One day pre-conference workshop is designed for young researchers and aspiring failure analysts. The workshop focuses on bringing out the understanding behind the engineering failures which would help in designing systems successfully with expected sustainability and prevent recurrence of the events. Lectures will be delivered by eminent experts in the field.

Conference

Two days National Conference on Failure Analysis (NCFA 2020) is being organized by Society for Failure Analysis (SFA). The first conference was held in the year 2006 at Hyderabad. This conference aims to bring together leading researchers, scientists, users and research scholars to exchange and share their experiences and research outcomes on all aspects of Engineering Failure Analysis. It will provide an excellent interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent trends, innovations, ideas, challenges encountered and solutions adopted in the domain of Engineering Failure Analysis.

About SFA

SFA was formed to serve as National Society to promote, encourage and develop the growth of "Art and Science of Failure Analysis" and to stimulate interest in compilation of a database, for effective identification of root causes of failures and their prevention thereof. The society received patronage from many stalwarts set the progress of the society in achieving its ambitions and goals-viz.- achieving safer and stipulated service life of components in various industries. The society conducts lecture series, annual meetings, workshops and clinics on various aspects of failure analysis and bring out a quarterly newsletter. Please visit SFA-India website (www.sfaindia.org) for more information.

Exhibition

The exhibition offers an opportunity for industries & equipment manufacturers related to material characterization and failure analysis tools to showcase their products and services to specialist audience gathered in the conference. The conference venue provides adequate resources for the exhibition. The details are uploaded in the conference website.

Sponsorship & Opportunities

Associated industries and institutions are requested to support NCFA 2020 by sponsoring the conference events. Depending on the nature of sponsorship, the conference provides business opportunities which include complimentary registration, business publication in the conference kit, company logo in conference documents, website and at the venue, complimentary pages in the souvenir and complementary stall at the exhibition. The details are posted in the conference website.

Registration Charges + 18% GST

	Workshop		Conference	
	Before 30 th April 2020	After 30 th April 2020	Before 30 th April 2020	After 30 th April 2020
SFA Members	2500/-	3000/-	5000/-	6000/-
Non-SFA Members*	4000/-	4500/-	6500/-	7500/-
Students	2500/-	2500/-	4000/-	4000/-

* It is highly recommended that participants join SFA as life members by paying Rs.2000/- and duly filling the application form available in SFA website.

Payment Details

Name of the Account	NCFA2020
Bank	Canara Bank
Branch	Vibhuthipura Branch
Account No.	8650201010456
IFSC code	CNRB0008650





Call for Papers

Abstracts of length limited to 500 words clearly indicating the work carried out and salient results, in the subject areas listed below in the brochure are invited which may be submitted online in the conference website (www.ncfa2020.com).

Authors of accepted abstracts will be invited to submit (up to a maximum of) eight page full length manuscript. The template for extended abstract and full length paper will be available at the website. The conference solicits contributions of abstracts, papers and posters that address themes and topics of the conference, including figures, tables and references of novel research materials.

Conference Structure

Conference is structured with keynote address, plenary and invited lectures apart from contributed papers from researchers as Podium / Poster presentations. Oral presentations would be in parallel sessions and major talks would be held at the main auditorium.

Conference Presenter's Policy

At least one author of the paper is expected to register and participate in person to present the paper. No presenter can present more than two papers accepted for this conference.

Relevant Topics

- Failure modes in metallic and non-metallic engineering materials
- Approaches to engineering failure analysis
- Role of service loading in failure of engineering structures and components
- Case studies of failures in industry sectors
- Aerospace & missiles applications
- Marine and offshore
- Nuclear power plants
- Automotive, railways, power generation
- Mining and minerals
- Armour, armaments and combat vehicles
 - Manufacturing & production including Additive Manufacturing etc.

- Structural and architectural failures
- Failure analysis and joining technologies
- Role of NDT in failure avoidance
- Failure analysis, maintenance and reliability
- Role of failure analysis in the design process
- Training and accreditation in failure analysis research and industry
- Role of condition monitoring and signal processing in engineering failure analysis

About Bengaluru

Bengaluru, famously known as 'garden city' and 'silicon valley of India' is also recognized as the 'aviation hub of India'. It is the state capital of Karnataka. It has a pleasant weather.



Important Dates

Online Abstract submission	March 31, 2020
Acceptance notification	April 15, 2020
Full length paper submission	May 15, 2020
Communication of review outcome of manuscripts	May 31, 2020
Submission of revised manuscripts	June 10, 2020
Pre-conference Workshop	July 9, 2020
Conference dates	July 10-11, 2020

Contact

Phone: 080-25040343
 Fax: 080-25241507
 E-mail: ncfa2020@gmail.com





SFA awards for 2019



SOCIETY FOR FAILURE ANALYSIS (SFA)
Hyderabad, India
(Regd. No. 97/2008)

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Shri YS Gowalkar, Metatech, Pune
Shri SD Lagavekar, RCMA (Nasik), Nasik
Shri Prabhat Gupta, RCMA (Lucknow), Lucknow

Contact Us at:

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No.: SFA/2019/10/A01

Dated: 21/10/2019

SFA Awards (2018-2019)

Dear Sir/Madam,

Subject: Notification for Nominations for SFA Awards – Reg

In order to recognise and honour scientists, engineers and academicians who have made significant and excellent contributions to the field of failure analysis, SFA presents awards. We are happy to announce notification for receiving nominations from individuals for the year 2018-2019 for the following categories of awards:

✓ SFA Lifetime Achievement Award	1
✓ SFA National Failure Analyst Award	2
✓ SFA Young Failure Analyst Award	1
✓ SFA Best Paper Award	2

Details with respect to above awards, eligibility, nomination form, supporting documents, citation, etc. are placed on the SFA website. The nominations will be scrutinized by an eminent panel of judges and the awards will be bestowed during annual event of our Society.

Members of SFA are requested to give wide publicity to this notification and are encouraged to send nominations to the undersigned in a sealed cover on or before 30th April 2020 to the Secretary's address.

Thanking you and with best regards,

(P. Parameswaran)

To

All EC members
All Chapter Chairmen

For Private circulation only

To

From
Society for Failure Analysis (SFA)
C/O Centre for Military Airworthiness &
Certification, RCMA (Materials),
Kanchanbagh
Hyderabad-550058