INVEST-2025
Special Issue

amplitude

2025, Issue - 2 & 3

DIAGNOSTICS
&
PROGNOSTICS
NEWS

COUNCIL OF VIBRATION SPECIALISTS

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HAPPY DIWALI

INDEX

CVS Vision & Mission

Our Vision

CVS aspires to be the center of eminence at the national and global level for the dissemination of knowledge in the field of vibration science and engineering, through training and post graduate studies, to formulate standards, collaborate with national and international regulatory bodies on vibration science and engineering, to develop and compile information in the field to assist engineers in building reliable, vibration free, stable and longer lasting products in the form of machines, structures and systems

Our Mission

To provide a platform for scientists, researchers and engineers to come together for exchange of vibration knowledge through training programs, seminars, conferences, campus and corporate visits, vibration solution services, recognition of contribution made by the experts in the fields.

To collaborate with similar national and international institutes and organizations for imparting customized various levels of certified training programs, certifying the asset's integrity in industry and enhancing people's capability in solving vibration problems.

To review, modify/ establish vibration standards in the fields of emerging domains such as smart structures, transportation systems, machinery, etc.

IRISS
ENGINEERED RELIABILITY

The Game-changing Technology:
Motion Amplification

Quick RCA with Real-Time Vibration Visualisation

VIBRATION MONITORING & MOTION ANALYSIS

THE POWER OF TECHNOLOGY

SEEING IS BELIEVING.

Visualizing motion. Finding solutions.

Motion amplification is a non-contact camera and software-based technology for vibration visualization and analysis that enables you to visualize as well as quantify vibrations invisible to the naked eye and help you perform the RCA in a matter of minutes with millions of data points in contrast to 10-12 from traditional analysis.

IRISS APAC had an exciting and interactive seminar at Navi Mumbai with the **Council of Vibration Specialists (CVS)** discussing about the Game-Changing Technology in the field of Vibration Analysis, Motion Amplification. Exploring about the wider spectrum of area of applications, Motion Amplification gives new ways to monitor asset health while significantly reducing the RCA time from days to minutes!

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From the Editor's Desk

Dr Barun Chakrabarti, FCVS

Dear Colleagues,

Greetings from the Editorial Team of "amplitude".

We take pleasure in bringing to you the latest issue of our Newsletter. This is a combined issue of the publication, covering (April – June) and (July – September) quarters.

Coming in the wake of our mega event, INVEST-2025, the highlight of this issue is naturally the round-up of the Conference. As we all know, INVEST-2025 turned out to be a spectacular show, despite the initial uncertainty and challenges posed by the unforeseen postponement of the program. For those who joined the Conference in person, the Newsletter coverage will bring back glimpses of the colourful event and a rush of pleasant memories. For those who could not make it to the Conference, the details inside will offer a ringside view of all the actions and excitement from this grand event.

From INVEST-2022 to INVEST-2023 and now INVEST-2025, the flagship event of CVS has been growing in all aspects, be it the scale, grandeur, technical quality and level of interest created among authors, delegates, sponsors, exhibitors and the technical community at large. We have been very fortunate and privileged to have a high-profile ensemble of Chief Guests, Guests of Honour and Patrons in all the three Conferences. Their active support, able guidance and good wishes will no doubt take CVS to greater heights.

On the 15th of August 2025, together with our 79th Independence Day, the CVS family celebrated the 5th Foundation Day and 4th Anniversary of CVS through a colourful online event, curated jointly by CVS Headquarters and the Students Chapter at FCRIT – Navi Mumbai. Please have a look at the highlights inside, particularly the technical talks by two eminent experts, which blended the spirit of celebration with learning and knowledge sharing.

This issue of the Newsletter also showcases various achievements of our esteemed members over the past few months. As always, they continue to make us proud and keep the CVS flag flying high. Our heartiest congratulations and best wishes to all of them in their pursuit of excellence.

As you read this issue, we would be in the middle of our long and much-awaited season of festivals and celebrations, stretching all the way to the year end. The Editorial Team conveys its best wishes and festive greetings to all of you and your near and dear ones.

Happy Celebrations!

Special Report: INVEST-2025 in Retrospective

Dr. Tarapada Pyne, FCVS,
Secretary & Director General

The third edition of CVS's flagship event, INVEST- 2025 (International Conference on Vibration Engineering, Science and Technology), was jointly organized by the Council of Vibration Specialists (CVS) and Indian Institute of Technology, Delhi (IITD), hosted at the magnificent Learning Hall Complex (LHC), IITD campus from 03 July to 05 July 2025. The event brought together the entire diagnostics fraternity indeed. The well-wishers and passionate specialists in the domain of omnipresent vibration joined INVEST-2025 and invested their time and brain on deliberations over Asset Excellence, Asset Diagnostics and Prognostics.

The Nation's high-profile Honourable Guests, Distinguished Guests, Author-Presenters, Delegates from PSUs, Private Corporates, R&D Laboratories, CSIR, DRDO, Defence Experts, Corporate Associates of global fame, Keynotes and Invited Speakers, and Academia decorated this glittering event. CVS is proud to be associated with the Department of Civil Engineering (currently top-ranked in India) of this eminent institute of the country, IIT Delhi. The delegates, speakers, guests, exhibitors - all were jubilant and vibrant in every part of the event and exchanged knowledge and experience on vibration and allied sciences.

The experts, practitioners, researchers, products and services providers actively networked and deliberated on what best could be done to enrich proven diagnostic technologies, to be smarter and more innovative in line with the conference theme 'Innovation and Smart Solutions'. Over three days, the participants discussed a wide range of topics. Key considerations included: how industries could leverage smart solutions in vibration and allied fields, what best inter-disciplinary studies, research, engineering and maintenance activities could be institutionalised to get cost-effective and faster solutions in management of assets under dynamic operations. This 'systems approach' to the study and application of vibration theories and the use of the latest digitization technologies, including IIoT, AI and ML were the abiding themes through the conference

Glimpses of Venue on the Inauguration Day

The pre-conference Tutorial sessions by renowned experts were organized on the first day. An eminent panel of speakers spoke on specialised topics. Around 100 participants attended the sessions. The participants include practising engineers, senior managers, faculty from academia, PhD scholars, researchers from Government R&D Labs, specialist engineers from our corporate associates and senior defence personnel. The sessions were greatly appreciated and well-received. At the end of sessions on the first day, the participants were presented with INVES-2025 Pre-Conference Tutorial Certificate. Tutorial speakers included CVS Fellows, Dr Tarapada Pyne, CKO & Director, CRD, Mumbai; Er. L J Swaminathan, CEO & Director, ModAE, Bengaluru; Dr. Srinivas Voggu, Chief Scientist and Head – SHM, SERC- CSIR, Chennai; Er. Abhay Chandajkar, MD, Asset Innovative Services, Muscat, Oman; Prof. (Dr) Arnab Banerjee, Dept of Civil Engineering, IIT Delhi; Prof. (Dr) Minoru Sasaki, Retd. Sr. Professor, Gifu University, Japan; Er. Babla Ghosh, Technical Head, SDT Ultrasound Solutions, Kolkata; Er. Anoop Saxena, SME- Asset Management; Er. Manohar Chidurala, Director, UE Systems and Er. Praveen Gupta, COO, AIVA Tech Solutions,

Glimpses of Day-1, Tutorial Sessions

Glimpses of Day-1, Tutorial Sessions

The second day was the starting day of conference, with the Inaugural Ceremony in the presence of high-profile dignitaries from industry and academia. The Guests of Honour who graced the event were Shri Vidya Rattan Sharma, Vice-Chairman, Jindal Steel & Power Ltd (JSPL); Air Mshl Vijay Kumar Garg, AVSM, VSM, Air Officer Commanding-in-Chief (AOC-in-C), Maintenance Command, Indian Air Force; Prof. (Dr) T. G. Sitharam, Chairman, All India Council of Technical Education (AICTE), Govt. of India; Shri Neeraj Agrawal, President - Nuclear Power, JSW Energy Ltd, Mumbai and Shri T. Kumaresan, Sr Vice President & Head - Larsen & Toubro, Metals and Mineral Company; Shri S V R Subramanyam, ED, EIL, New Delhi.

Welcome to our Distinguished Guests to the Venue

Lamp Lighting by Guests during Inaugural Ceremony

Inauguration Day, Guests on Dais

CVS Officials Welcome Esteemed Guests

CVS Officials Welcome Esteemed Guests

The event started with the welcome speech by Er. Prasenjit Pal, Chairman, CVS New Delhi Chapter, who invited the Guests on the Dias, followed by lighting of the auspicious lamp by the dignitaries. This was followed by Saraswati Vandana by Mrs. Dhansree Chandajkar, invoking the divine blessings on this occasion. The CVS video was then played to make the august gathering aware of the genesis of CVS, its Aims & Objectives, various initiatives and the journey so far. Dr. H S Gambhir, President, CVS, addressed the audience after acknowledging presence of the esteemed Guests, and introducing the INVEST-2025 event. He also outlined the accomplishments of CVS so far and its aspirations, setting a positive tone to the conference. Dr. Tarapada Pyne, Secretary and Director general, CVS, spoke on the on-going activities and future plans in serving the industries of this great Nation through exchange of diagnostic knowhow and how CVS can be the catalyst in harnessing experts' knowledge, mentoring students and engineers to make a career in vibration and allied fields, and the need of collaboration with Government Agencies and Corporates. He reiterated that CVS believed in 'Employability before Certifications' in evaluating and upskilling Nation's engineers and highlighted the signing of an MoU with the Capital Goods Sector Skill Council (CGSSC) to start education and training programs in vibration and diagnostics, with a structured syllabus developed by experts (at par with International Standards and possibly surpassing these). With the self-reliance philosophy of "Make in India" and "Atma Nirbhar Bharat", CVS aims to nurture the skilling needs in Vibration Science with the mantra "Skill India By India's Skills". Dr. Vasant Matsagar, Conference Convenor and Head of the Department of Civil Engineering, IIT Delhi, emphasized the significance of INVEST-2025, IIT Delhi's close association with this mega event and its keen interest to serve the monitoring and diagnostic fraternity. The guests were then felicitated by Dr H S Gambhir, Dr T. Pyne, Dr. V. Matsagar, Er. Prasenjit Pal, Dr Ravinder Goyal, Er Girish Doddamani, Dr. S. M. Khot, HQ and officials from New Delhi Chapter of CVS.

Saraswati Vandana by Mrs. Dhansree Chandajkar

Inauguration Day Speeches by CVS Officials

Moving on, it was the turn of the esteemed Guests to speak on the occasion.

Shri V R Sharma emphasized the challenges of vibration control in steel industry, as the critical value-adding assets of steel manufacturing processes are compressors, pumps, power turbines, high-capacity overhead cranes etc operating in harsh environment of dust and heat. He narrated his experience in maintaining these assets and related vibration issues. In his speech, he requested scientists, engineers, specialist to help industries to reduce ill-effects of vibration and approach the operators to resolve the issues through providing services and specialized training of employees.

Air Mshl. V K Garg delivered the speech on the preparedness of air defence system and the need of latest Maintenance Technologies in various air bases to keep our flying machines worthy of responding to any external aggression and to keep our border safe. He focussed the importance of structure and rotary machinery in helicopter, aircrafts, ground supporting assets which are prone to vibration. These flying machines experience vibration in internal drives due to rotors, structural and aerodynamic forces influencing stability accuracy of machines meant for strategic military operation while in air. He drew attention to indigenization of military aviation for self-reliance in improving reliability of military aviation. He narrated how Indian Air Force (IAF) is dedicated to accomplish these tasks through Base Repair Depots located across the Nation and urged CVS's specialists to reach out and assist in various vital areas of strategic importance.

Prof. T G Sitharam stressed upon the nation's education system, on-going revamping the system, implementing National Education Policy, industry-institute collaboration, the skilling of our engineers to meet current challenges of AI. He reminded and pointed out the vital role of CVS and INVEST conferences in bringing experts together in inter-disciplinary vibration, noise, and dynamics specialization and how three generation of learners can do extraordinary works towards Vikshit Bharat. He emphasized the current need of AI and ML knowledge for our engineers, scientists and researchers to have readiness to face these challenges and how AICTE is in the leading role to support academia and industry in building this great Nation. Engineers must try again and again to accomplish the goal, learn to fail first, so that they are seasoned to reach success one day.

Inauguration Day Speeches by Esteemed Guests

Shri Neeraj Goyal narrated his four decades of experience in operating and maintaining critical rotary machines in nuclear industry. He focused on the need of system approach of predictive maintenance to solve machinery problems. Academia and industry collaboration would bring innovative solutions. Shri T Kumaresan emphasized the importance of vibration studies in metal industry, starting from plants commissioning and in entire life span. The problems can be resolved when suppliers, erectors and asset owners understand the effects of vibration and he focused on collaborative approach by all the stakeholders. Shri S V R Subramanyam drew attention to the current advancement of diagnostic tools and their uses in diagnosing machinery vibration problems and keeping them reliable. There is need to locate the exact sources of vibration in rotary, structures and connected machinery to resolve the vibration problems and he shared his experience in EIL and client's operating plants.

Inauguration Day Speeches by Esteemed Guests

Inauguration Day Speeches by Esteemed Guests

CVS Officials welcome Esteemed Guests

Delegates from Industry and Academia in Inauguration

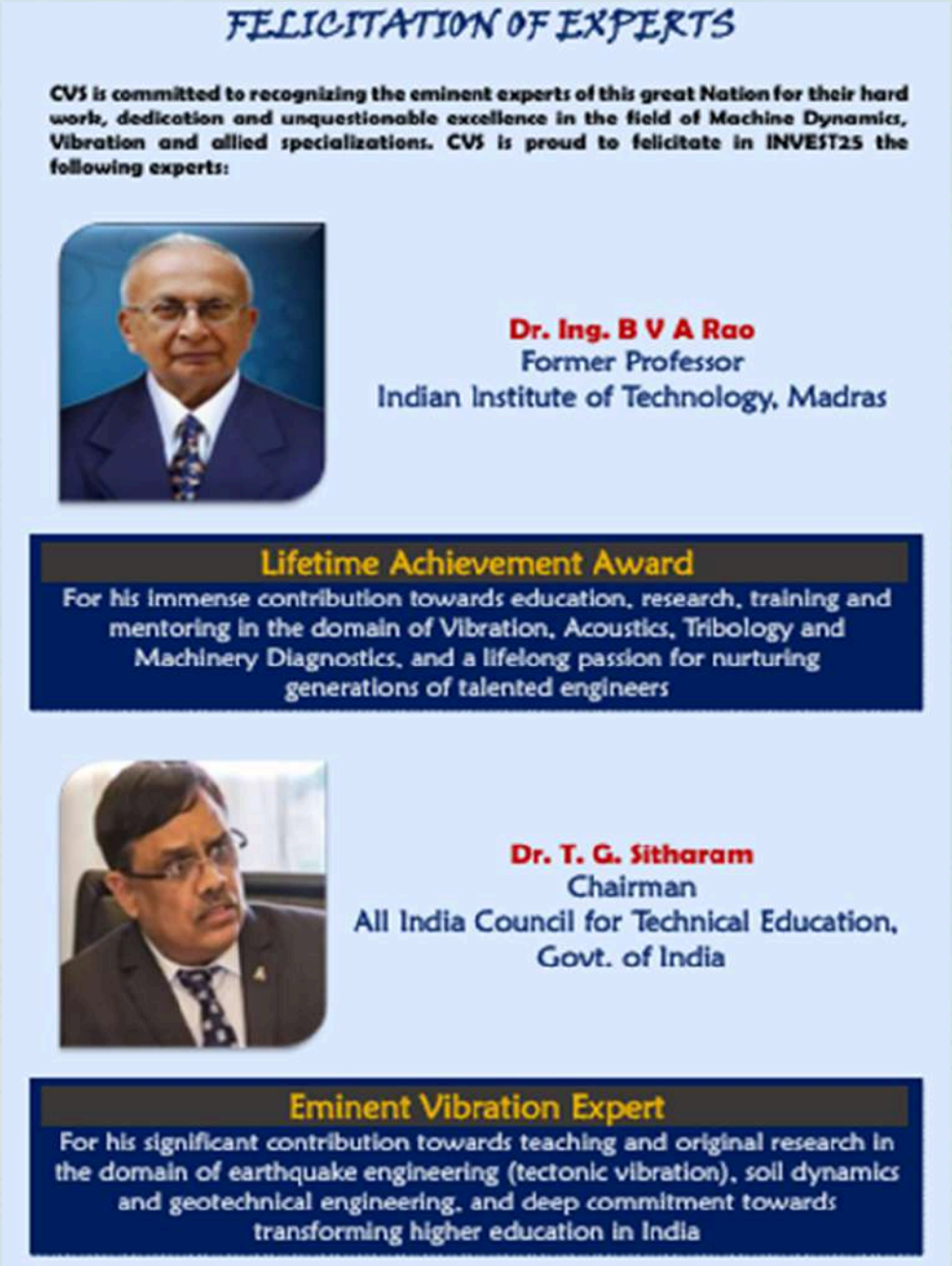
Delegates from Industry, Academia and Defence in Inauguration

One of the most important events during the inauguration was the signing of an MoU with Capital Goods Sector Skill Council (CGSSC). The formal document was signed in presence of Ms Shalini Singh, CEO, CGSSC; Shri Sanjay Bhardwaj, Vice President, CGSSC; Dr Suhas Deshmukh, Director, NCVET, New Delhi; Dr Tarapada Pyne, Secretary & DG, CVS; Dr H S Gambhir, President, CVS and Er N P Sundar, CVS Fellow and Laison Officer with CGSSC. Once the program is rolled out, India's Capital Goods Sector will derive significant benefit through specialised skill-building on vibration and other allied fields.

Signing of MoU with Capital Goods Sector Skill Council (CGSSC)

As in the past two conferences, INVEST-2025 was the right platform for CVS to recognise and felicitate India's renowned experts in the domain of Vibration and allied Technologies. Dr T G Sitharam, Chairman, AICTE and Fellow of CVS, former Director, IIT Guwahati was felicitated with CVS's National Award *"Eminent Vibration Expert"* for his outstanding contributions in research and education in the field of Soil Dynamics, Structures and Seismic Vibration. The award also recognised his key roles in developing India's critical infrastructure programs, including Chenab bridge project. Dr-Ing. B. V. A. Rao, Fellow of CVS, was bestowed with the *"Lifetime Achievement Award"* for his immense accomplishments in education, research and training in Vibration, Noise and Condition Monitoring technologies throughout his illustrious career spanning over six decades. He is a distinguished academician and served many prestigious institutions such as IIT Bombay, IIT Madras, VIT University - Vellore, KL University - Vijayawada and Sir MVIT – Bengaluru with distinction.

Besides the felicitation of CVS Awardees, a total of 11 members received their CVS Fellowship Certificates from the hands of distinguished guests.



Felicitation of Nation's High-Profile Experts

Felicitation of Esteemed Guests, the Shapers of New India

Conferring CVS Fellowship on Guests

Release of INVEST25 Souvenir by Guests and CVS Officials

Following the felicitations, the INVEST-2025 Conference Souvenir was formally released by the dignitaries present on the dais. The Souvenir served as a repository of key conference information, messages from dignitaries, details of various Committees, Conference Sponsors and Exhibitors, as well as a collection of Abstracts of technical papers.

The Inaugural Session concluded with a formal Vote of Thanks from the organisers.

A major attraction of INVEST-2025 was the Technical Exhibition, showcasing the latest products, services and solutions pertaining to the theme of the conference. The exhibition stalls were ceremonially inaugurated by the dignitaries, who also spent some quality time with the representatives of various partner companies present at the stalls and had a first-hand exposure to the latest tools and techniques being exhibited. A total of 13 Exhibitors took part in INVEST-2025, which included Forbes Marshall, IRISS, Nanoprecise, Technouniq, Adams Technologies, ATS, SDT Ultrasound, Aral Tech, Cori Rubbers, Ptek and Biltz.

Exhibition Inaugurated by Esteemed Guests

Esteemed Corporate Associates

Guests and Delegates at Exhibition Booths

Distinguished Technical Session Chairpersons and Presenters

To encourage the efforts and achievements of presenting authors, CVS instituted four Best Paper Awards, two each from industry and academia. The awardees were selected through a structured evaluation process by an eminent panel of jury members. Following award cases were selected for recognition and appreciation at INVEST-2025:

- **Best Paper Award: Industry**

  Winner:
  Sudha UPV, Jagath C M, Vellaisamy Dinu
  Aeronautical Development Agency (ADA), Bengaluru
  Title of Paper: Generation of Buffet Pressure PSD for a Generic Fighter Aircraft Using Wind Tunnel Test Data
  Runner-up:
  Prashant E. Vishe, *Innovation & Research and Fatigue Test Lab, International Centre for Automotive Technology (ICAT), Ministry of Heavy Industry, Govt of India*
  Title of Paper: Automotive Testing and Consulting Services at ICAT

- **Best Paper Award: Academia**
  Winner:
  Sibi K, Siddanagouda Kandagal
  Dept. of Aerospace Engineering, Indian Institute of Science (IISc), Bengaluru
  Title of Paper: Application of Enhanced Deep Learning Techniques in Structural Health Monitoring
  Runner-up:
  Dhananjay Panchagade, Sarthak Varma, Amar Murumkar
  Dept. of Mechanical Engineering, FCRIT Navi Mumbai, University of Mumbai
  Title of Paper: Reliability study of Quad Flat Pack subjected to vibration and thermal aging

In between technical sessions, the Quiz Time livened up the proceedings. The CVS Quiz Master, Er. Mahesh Kumar, DGM - EIL, New Delhi conducted the quiz sessions on both days with his own professional skills, marked with humour and fun-filled competition.

The presence of a galaxy of senior Air Force officers was a key highlight of INVEST-2025, marking a collaboration between the technical community and the defence forces. The Air Force team was keen to learn about the latest technology solutions in vibration & noise, machinery monitoring and diagnostics, and actively engaged with the experts and speakers to explore how these could be leveraged to better manage the critical defence assets.

A Galaxy of Senior Air Force Officers Decorated the Event

The Panel Discussion, scheduled on the third day, was moderated by Er N P Sundar, CVS Fellow and Director - Stellar Innostrat Consulting, Navi Mumbai. The session was well-presented, with nicely-curated discussion on the latest topics on machinery management and diagnostics. The Panellists, comprising industry experts Shri Pramod Sapra, President, SPARMADA, Mumbai; Shri Umesh Kumar Vishwakarma, MN Dastur & Co., New Delhi; Prof. (Dr) Arun Jalan, Dept. of Mechanical Engineering, BITS, Pilani and Shri C S Azad, KRIBHCO, Surat took part in the discussion. The session concluded with an open forum, with active participation from the audience.

Esteemed Panellists in Discussion

Recipients of INVEST25 Best Paper Award

Felicitation of Authors and Presenters of Technical Sessions

The Best Student Chapter award was presented to CVS Student Chapter, FCRIT, Vashi, Navi Mumbai and the Runner-up was the CVS Student Chapter, RVCE, Bengaluru."

FCRIT, Vashi Receives Best Student Chapter Award

Glimpses of Panel Discussion

The entire conference proceedings were ably anchored by Dr Rajat Goyal and Dr Abhishek Goyal, along with the resource person from the event management team. The Jury members to select the Best Papers were Dr Pravin Jagtap, Principal Scientist, IITD and Dr Srinivas Voggu, Chief Scientist, SERC-CSIR. The Best Stalls selected were of Forbes Marshall and IRISS Inc. (Joint Winners), and the Runner-up was UE Systems, Hyderabad.

Dedicated Anchoring Team for the Entire Event Receives Award

Vibrant and Jubilant CVS New Student Chapter at IIT Delhi

A Few Moments of Refreshments

The catering and other services, including event management at site and off-the-site travel etc. were meticulously supported by M/s Ardour Brand Services led by Mr Ravi and Mr Jeet. Hotel and accommodation services and related arrangements were provided by IIT Delhi Guest House officers. Site Security and entry/exit facilitation for all delegates and supporting agencies were well managed by IITD security dept.

M/s Ardour Brand Services, the Event Management Team Appreciated

M/s Ardour Brand Services in Event Management

The event was also supported by IIT Delhi Student Chapter. Mr Shashikant Kavar from CVS HQ, together with Mr Radhey Shyam Tiwari and Mr Arun Gupta supported the entire event, from the registration desk to managing all administrative tasks in and out of venue

The curtains came down on INVEST-2025 on a happy note, as dignitaries, sponsors, delegates and other stakeholders shared their enchanting responses and appreciations for a mega event successfully organized. All eyes are now on the next edition, INVEST-2027. Here is wishing the very best for the next conference, and we all aspire to put on an even bigger and grander show.

Organizing Committee & Attending Governing Council Members

Curtains came down with a commitment of better INVEST2027

Felicitation: Prof. Dr.-Ing. B V A Rao

CVS Lifetime Achievement Awardee -2025

Prof. Dr.-Ing. B V A Rao, the CVS Lifetime Achievement Award Winner for 2025, could not attend the Award Ceremony at Delhi during the INVEST-2025 event, in view of his advanced age. The Award was presented to him at his residence in Bengaluru on 17th August 2025, in a solemn and simple felicitation ceremony. Er. Girish Doddamani, Secretary – CVS Bengaluru Chapter and CEO – Enviro Sense Tech., along with Prof. (Retd.) Chandrababu C.K., BMS College of Engineering, Bengaluru visited Prof. Rao on this memorable occasion. They spent over two enriching hours with Prof. Rao, during which he graciously showed them his private library containing more than 1,000 books on Acoustics, Vibration, and Tribology. In a remarkable gesture, Dr. Rao has offered to donate his entire collection to the Council of Vibration Specialists. This contribution will be a treasure for our community and future generations of vibration specialists.

Bouquets of Messages: INVEST-2025

Message from

Prof. Dr.-Ing. B V A Rao, FCVS

CVS Lifetime Achievement Award Winner - 2025

Dear Dr. Pyne

Thank you for sending the Souvenir and exhaustive report on the International Conference INVEST 2025 held in IIT Delhi. Congratulations to all of you at CVS for its great success in view of the presence of many distinguished personalities as well as presentation of quality papers by many professionals in the field. This is the first conference exclusively conducted in the field of VIBRATION alone. The credit goes to CVS for making Vibration as an important subject for the Designers and Manufacturers of our Indian machinery of all types. I wish personally great success for CVS for all their efforts in this regard.

The Souvenir has come out very well and deserves commendation of all those in charge of this task. Thanks for including my name under the caption Lifetime Achievement Award. I look forward to the original certificate duly signed for my record and I hope you are at it. I only feel sorry that I could not attend such a great event of my interest, in which I have worked nearly 70 years. I will be sending you shortly a set of books which I have contributed to both Academicians and Industrialists.
Best Regards to you as well as the President and other members of CVS.

With warm regards
Yours sincerely
Dr.-Ing. B.V.A.Rao

Message from
Er. Manohar Chidurala, FCVS
Director - UE Systems
Tutorial Session Speaker & Exhibitor

Attending INVEST-2025 at IIT Delhi, organized by the Council of Vibration Specialists, was a highly valuable and professionally enriching experience. The event brought together leading experts and practitioners in the fields of vibration engineering and condition monitoring. I had the privilege of representing UE Systems India, where we specialize in ultrasound-based predictive maintenance solutions focused on leak detection, asset reliability, and energy conservation. The technical sessions, panel discussions, and live interactions provided meaningful insights into emerging trends and practical applications in our field. It was encouraging to see growing interest in the integration of ultrasound technology within broader maintenance strategies. I would like to extend my sincere appreciation to Dr. Pyne, Dr. Gambhir, and the organizing team for curating such a well-structured and impactful event. The level of engagement and knowledge sharing was exceptional. I look forward to continued collaboration and applying these insights to drive innovation in reliability and maintenance practices.

Message from
Er. Partha S. Ghose, FCVS
Director (Projects), Kalyani Steels Limited
INVEST-25 Technical Session Chair

Kudos to you…
Heartiest congratulations to the entire organising team for the resounding success of the 3-day International Conference on Vibration Engineering, Science and Technology, INVEST 2025. The event stood out for its exceptional planning, seamless execution, and remarkable academic depth, bringing together thought leaders, researchers, and practitioners from across the globe. Your dedication, professionalism, and attention to detail have set a benchmark in conference hosting. The enriching technical sessions, meaningful collaborations, and vibrant intellectual exchange will surely leave a lasting impact on the field. Kudos to each one of you for orchestrating such an outstanding and inspiring event!
Partha S. Ghose, PMP®
Director (Projects)
Kalyani Steels Limited, Pune
Member, Project Management Institute, USA (PMI)
Member, Association of Iron & Steel Technologists, USA (AIST)
Fellow, Council of Vibration Specialists, India (CVS)

Bouquets of Messages: INVEST-2025

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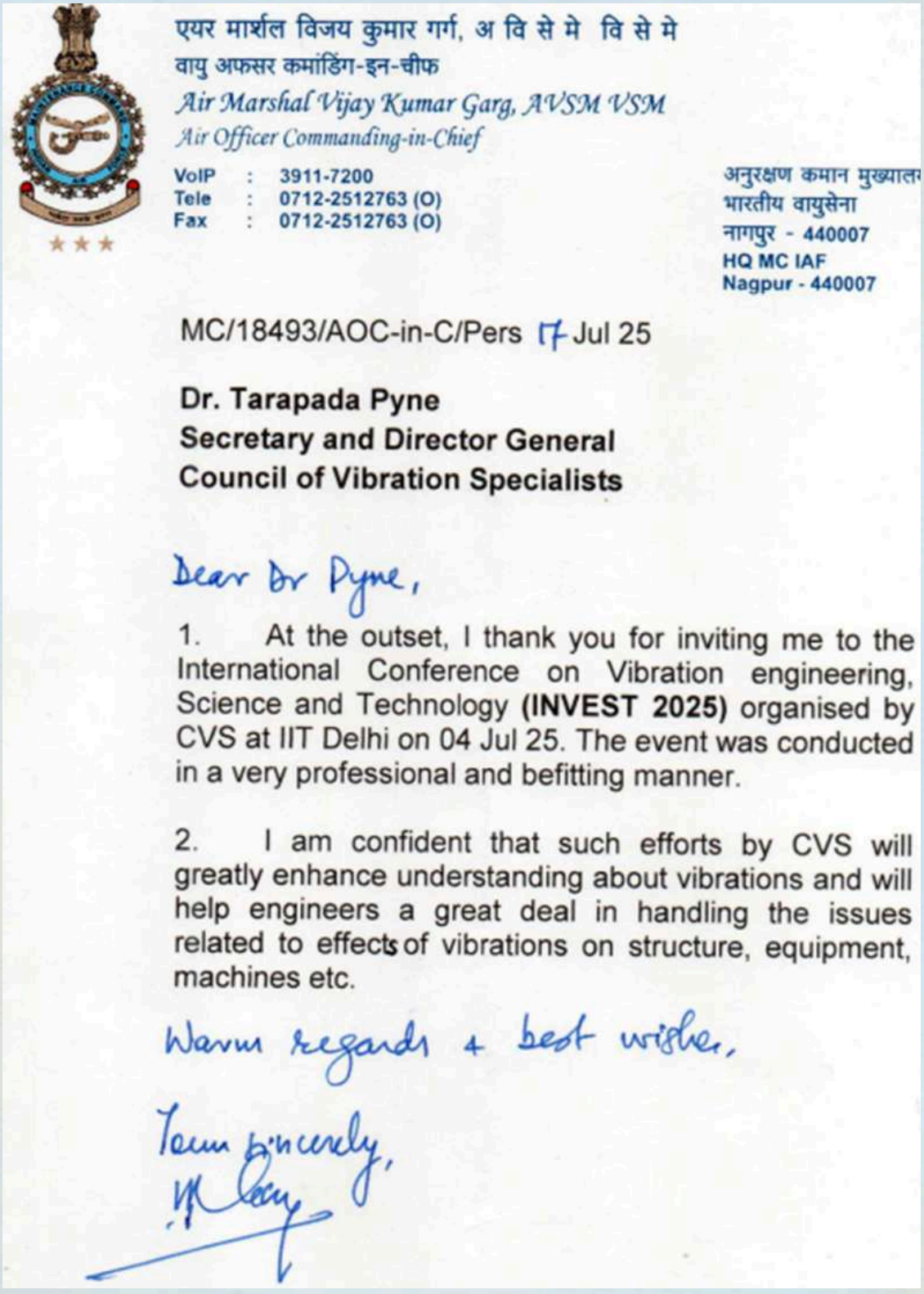
Message from
Air Marshal V. K. Garg, AVSM, VSM
Air Officer Commanding-in-Chief
INVEST-25 Guest of Honour



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MC/18493/AOC-in-C/Pers 17 Jul 25

Dr. Tarapada Pyne
Secretary and Director General
Council of Vibration Specialists

Dear Dr Pyne,

1. At the outset, I thank you for inviting me to the International Conference on Vibration engineering, Science and Technology **(INVEST 2025)** organised by CVS at IIT Delhi on 04 Jul 25. The event was conducted in a very professional and befitting manner.

2. I am confident that such efforts by CVS will greatly enhance understanding about vibrations and will help engineers a great deal in handling the issues related to effects of vibrations on structure, equipment, machines etc.

Warm regards & best wishes,

Yours sincerely,

Bouquets of Messages: INVEST-2025

Message from
Er. M S Murali, SMCVS
IL&FS Tamil Nadu Power Co. Ltd.
Conference Delegate

INVEST 25 – A Grand Confluence of Innovation, Excellence, and Collaboration

INVEST 25 was more than just a conference, it was a landmark moment. Hosted this year at the iconic IIT Delhi, one of India's premier institutions, the event brought together 100+ participants and showcased 10+ vibrant industry stalls. For many attendees, the opportunity to step into a world-class campus, attend sessions led by IIT associate professors, and experience the rich blend of Delhi's classical heritage and modern infrastructure was truly unforgettable.

A Unique Fusion of Academia, Industry, and Defence

This year's edition marked a powerful convergence of minds from Navaratna public sector giants like BHEL, EIL, and the Indian Navy, to pioneering private sector leaders including TATA, Adani, ILFS,SKF. The academic presence was equally impressive, featuring Ph.D. scholars from IITs, professors from Abdul Kalam University, and scientists from SERC and the Aeronautical Development Agency.
The keynote speakers brought immense credibility and energy, with highlights including:

- **Prof. Dr. T.G. Sitharam,** Chairman, AICTE
- **Air Marshal V. K . Garg**
- **Mr. V. R. Sharma,** Managing Director, JSL
- **Mr. T. Kumaresan**, Vice President, L&T
- **Mr. Neeraj Agarwal,** Director, JSW
- **Mr. Subramanyam,** Executive Director, EIL

Their insights added immense value and marked INVEST 25 as a stage of serious thought leadership.

Inclusivity at Its Core – From Trainees to Titans

At CVS, we believe in equality across experience levels. Our interactive quiz sessions proved just that—breaking barriers and creating an atmosphere where everyone from trainees to directors engaged actively. The enthusiasm was palpable, and success stories emerged from all corners, from industry veterans to young scientists. This energy was just the icing on the cake.

Industrial Impact, Thought Leadership, and Stronger Networks .

The motivation and technical depth shared by our eminent speakers were endless. Special focus was given to Condition Monitoring and its evolving role in Structural Health Monitoring (SHM) a growing necessity in today's industrial landscape. The pre-tutorial session offered deep, hands-on learning, which many attendees echoed on LinkedIn, validating the relevance and quality of the content.

Our stalls didn't just showcase technology, they sparked new business inquiries, initiated collaborations, and broadened professional networks. ***INVEST 25*** once again reinforced that C***VS is not just growing - it is guiding the industry forward***.

CVS Celebrates 5th Inauguration Day and 4th Anniversary on the 79th Independence Day of India

CVS Students' Chapter at FCRIT - Navi Mumbai hosts the colourful online event

As India celebrated the 79th Independence Day on 15th August 2025, the CVS Family also joined the festivities to mark the 5th Inauguration Day and the 4th Anniversary of the organization.

The Students' Chapter at Fr. C. Rodrigues Institute of Technology - Navi Mumbai joined hands with the Headquarters Team to celebrate this milestone. A colourful flyer announced the online event well in advanced. Apart from the reminiscences by the CVS Leadership Team on the CVS journey over the past four years, a key highlight of the event was two technical talks delivered by eminent experts, which blended the spirit of celebrations with learning and knowledge sharing. Around 30 CVS Members joined the afternoon event from all over the country.

The online event started off at 5.00 PM on the Independence Day with the auspicious Lamp Lighting ceremony and Saraswati Vandana. This was followed by the brief video clip on CVS Inauguration. Prof. (Dr.) S. M. Khot, Treasurer - CVS and Principal - FCRIT, presented the welcome address. Dr. Harvindar Singh Gambhir, President - CVS spoke on the eventful journey of CVS over the past four years, filled with many successes and achievements, but also tinged with occasional challenges. He encouraged the CVS members to come forward and actively take part in various CVS initiatives.

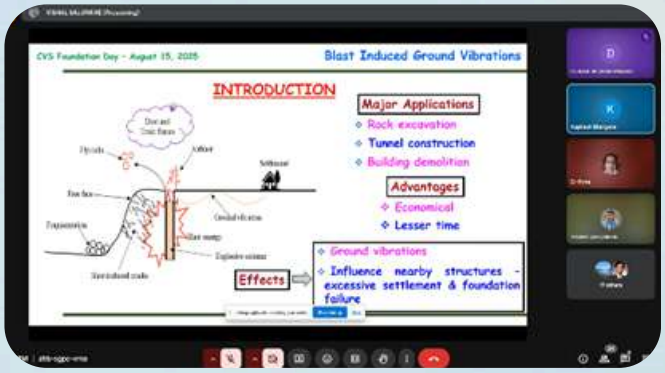
Dr. Tarapada Pyne, Secretary & DG - CVS, introduced the two eminent speakers of the afternoon. Dr. Kapilesh Bhargava, FCVS, Head - Structural Engineering Research, Bhabha Atomic Research Centre (BARC), Mumbai, and Prof. of Engineering Sciences at Homi Bhabha National Institute, Mumbai, joined the event as the Chief Guest. Er. Prashant E. Vishe, SMCVS, Senior Manager - ICAT Centre for Innovation and Research (ICIR), International Centre for Automotive Technology (ICAT), Manesar, participated as the Keynote Speaker.

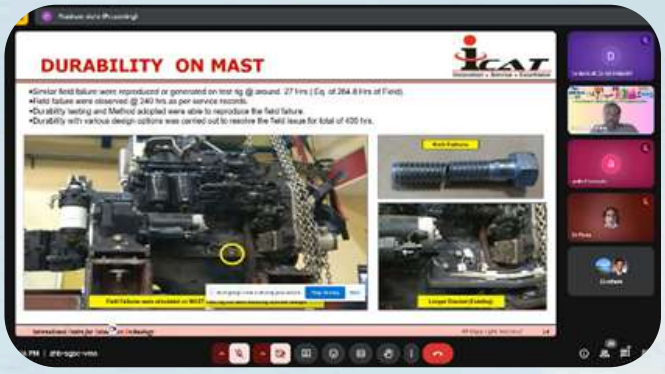
Dr. Bhargava then delivered his expert talk on the topic: "Assessment of Blast Induced Ground Vibration Parameters". The brief but informative lecture covered the basic concepts of ground vibration created during excavation, construction and demolition activities and the analysis of such vibration phenomena. Dr. Bhargava supplemented the theoretical concepts with experimental data on blast occurring in rocks and numerical simulation of shock wave propagation. He also presented the development approach for a Peak Particle Velocity (PPV) Model for rocks. The lucid style of presentation helped the participants appreciate the complex concepts within this specialized domain.

The speaker first explained the traditional approach of field testing, involving field data collection, data reduction/analysis and correlation with rig test data. He then presented the details of the MAST Testing Framework and examples of a few actual testing cases being performed on the MAST facility.

Both the talks were appreciated by the participants and led to some lively Q&A interactions. Following the two presentations, Prof. (Dr.) Vishal G. Shalunke, Mentor - FCRIT Students Chapter, presented the Vote of Thanks. The program concluded on a solemn note, with the participants jointly singing the National Anthem.

Here are a few glimpses from the event.





79th INDEPENDENCE Day 2025
15th August
2021
2025
5TH INAUGURATION DAY
CVS Celebrates 5th Inauguration Day & 79th Independence Day

FCRIT - Navi Mumbai Partners with CVS Mumbai Chapter to Conduct STTP

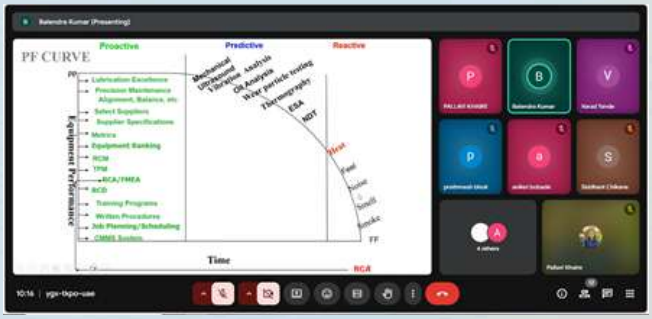
The Mechanical Engineering Department of Fr. C. Rodrigues Institute of Technology (FCRIT) – Navi Mumbai joined hands with the Mumbai Chapter of CVS to conduct a 6-Day Short-Term Training Program (STTP) on AI-Based Predictive Maintenance Strategies in Industry 4.0 during 21 – 26 July 2025. The program was coordinated by Ms. Pallavi Wajekar, Dr. V. G. Salunkhe and Mr. Amit Malgol.

Technical sessions were conducted in hybrid mode, with FCRIT faculty members delivering lectures in-person, while external speakers joined online for their talks. Fifteen Resource Persons conducted the sessions on diverse topics over the 6-day program. Many of the eminent guest speakers were closely associated with CVS, coming from industry, consulting firms and academia.

The training program was designed to offer a comprehensive understanding of vibration analysis techniques for diagnosing faults in industrial machinery. Key topics of discussion included: theoretical foundation of vibration analysis techniques; instrumentation facilities for measurement and analysis; features of commonly used software tools; techniques for performing data interpretation and fault diagnostics for various rotating machinery; details of common machinery faults and their characteristics; advanced techniques in condition monitoring, predictive analytics and diagnostics using the latest tools such as AI/ML, Big Data Analytics, Digital Twin and IIoT Framework. The course focussed on a balanced mix of both theoretical knowledge and practical applications, involving real-life case studies and hands-on demonstrations.

This course significantly enhanced the participants' theoretical and practical competencies in predictive maintenance using AI/ML and IIoT technologies. It helped in bridging the gap between traditional approach to vibration analysis/predictive maintenance and the new, technology-driven approach involving AI/ML and IIoT applications.

A feedback survey was conducted after the program covering parameters such as relevance of contents, effectiveness of sessions, quality of hands-on exercises and coverage of real-world applications. The program received top-rated feedback from the participants on all the attributes assessed. A Certificate of Appreciation was awarded to all the participants.



Guidelines for Contributors to "amplitude" Newsletter

- Members are encouraged to contribute short technical notes, articles and other regular features for publication in ***"amplitude"***. Technical articles should be restricted to 4-5 pages (including all figures / illustrations).
- Submissions can be sent to the Editor at barunc1964@gmail.com, with a copy to CVS Headquarters at covshqs@gmail.com
- All text matters should be submitted in editable MS-WORD format with 12-pt Times New Roman font and 1.15 line spacing, in single-column A4 size page
- All figures/illustrations and photographs should be submitted as image files (.jpg. .jpeg, .png etc.)
- Please do not submit entries in PDF or MS-PowerPoint format.

Know Our Members

Dr. Atul V. Karanjkar, FCVS

Dr. Atul V. Karanjkar is a distinguished professional mechanical engineer with 20 years of academic and research experience, complemented by 5 years of industrial experience. Presently, he is affiliated with SmartDynamx, Nashik. He holds a Ph.D. in Mechanical Engineering from the National Institute of Technology Durgapur, West Bengal, specializing in vibration-based condition monitoring, noise control design, machinery dynamics, and mechatronics.

With an impressive record of publications in international journals, Dr. Karanjkar has authored 21 papers and holds a patent. He has received the INSA fellowship award and has supervised and examined Ph.D. scholars. Actively engaged in industrial consultancy, he provides vibration analysis, design, and manufacturing services to industries in Mumbai and Nashik.

As a life member of several professional bodies, including ISTE, CVS, and TRSI, Dr. Karanjkar has organized and participated in numerous national and international workshops, Short-Term Training Programs (STTPs), and conferences.

Er. Anoop Saxena, FCVS

Er. Anoop Saxena is a seasoned professional with over 39 years of rich experience in System Management, Project & Maintenance, and Asset Management Implementation. He is an expert in Reliability-Centered Maintenance (RCM) and Condition-Based Maintenance (CBM).
He has held several key leadership positions including:
Senior Vice President – Usha Martin Ltd., Technical Head – Super Smelter Ltd., Assistant General Manager – JSPL, Director – AMC Consultancy & Training
A Mechanical Engineer from NIT Trichy, Mr. Saxena also holds a Post Graduate Certificate in Business Management (PGCBM) from XLRI, Jamshedpur, and received advanced training in RCM & CBM from the University of Manchester (UK).

He is a CII Business Excellence Assessor, System Auditor (IMS – ISO Systems), TPM & Plant Assessor, and has served as a Panel Judge for various national forums on TPM, Kaizen, and TQM.

Mr. Saxena has made numerous technical presentations and publications at prestigious national and international seminars including IMC Florida, BEMS Belgium, Maintenance Institute Africa (GMF), CII-TPM Club India, AIRM, Reliability Conferences, GEMS, IIPM, NPC, CPTI, SAIL-NSPC, MTI, RMC, and several industrial platforms.

He is also actively engaged in Talent Management, focusing on Skill and Knowledge Enhancement across organizational levels

Dr. Vishal G. Salunkhe, SMCVS

Dr. Vishal G. Salunkhe is an accomplished Associate Professor in Mechanical Engineering with over 10 years of academic and research experience, currently affiliated with Fr. C. Rodrigues Institute of Technology, Vashi, Navi Mumbai. He holds a Ph.D. in Mechanical Engineering from Shivaji University, Kolhapur, and specializes in Vibration Control, Tribology, Rotor Dynamics, Condition Monitoring of Bearings, Composites, and Machine Learning.

With an impressive record of 28 international journal publications, 5 book chapters, and multiple research grants, including funding from Shivaji University and FCRIT, Dr. Salunkhe is actively engaged in industrial consultancy, providing vibration analysis and fault diagnostics services to sugar and process industries across Maharashtra and Karnataka. He is a Life Member of several professional bodies including ISTE, CVS, TSI, and IEI, and has organized and participated in numerous national and international workshops, STTPs, and conferences

Er. M S Murali, SMCVS

Er. M S Murali is seasoned reliability engineer, condition monitoring specialist, and digital innovator, he has been associated with Cuddalore Thermal Power Plant owned by IL&FS since the start of its commercial operation. His career encompasses significant contributions at SKF Bearings, Adani Power, and Trident Energy, where he has advanced reliability practices and strengthened maintenance performance.

He holds a Bachelor degree in Mechanical Engineering and is certified as a Category III Vibration Analyst by the Vibration Institute, USA. In addition, he is a certified Maintenance Reliability Professional (SMRP, USA) These credentials reflect his expertise and dedication to ensuring optimal reliability and performance within the oil & gas and power sectors.
Outside his professional pursuits, he is an avid marathon runner and an enthusiast of non-fiction literature, interests that mirror his discipline, endurance, and pursuit of continuous learning.

Er. Amar Murumkar, MCVS

Er. Amar Murumkar is currently working as an Assistant Professor in Department of Mechanical Engineering, Fr. C. Rodrigues Institute of Technology (FCRIT), Vashi, Navi Mumbai. He is an accomplished academic and industry professional with over 18 years of combined experience—10 years in teaching and 8 years in industry. He holds a Master's degree in Manufacturing Systems Engineering from the University of Mumbai. His areas of interest include Quality Management, Project Management, Welding Technology, and Reliability Engineering. He is actively involved in skill development initiatives and is instrumental in conducting Welding Training Programs in collaboration with Fronius India Pvt. Ltd., under the FCRIT Centre of Excellence. Over the past two years, successfully conducted 15 Basic Welding Training Programs for students and industry professionals, enhancing practical skills and industry readiness.

He is a life member of the Indian Institute of Welding (IIW) and the Condition Monitoring and Vibration Society (CVS), reflecting his commitment to continual learning and professional development

आत्मनिर्भर भारत

WE VALUE `VOCAL FOR LOCALS' IN DIAGNOSTIC EDUCATION

Members in News

Heartiest Congratulations! We are proud of you.

Dr H S Gambhir, Founder-President of CVS, has been honoured with the Fellowship of the International Society of Automation (ISA). The Class of Fellows – 2025, announced by ISA, comprise seven distinguished individuals with exceptional achievements in the domain of Automation. ISA lauded Dr Gambhir's outstanding contributions to the field of automation in process instrumentation and controls used in oil & gas, refinery and petrochemicals sectors. The Fellowship Award was presented in a glittering ceremony during the ISA Summit & Expo held at Florida, USA during 5 – 7 October 2025.

Er. Prasenjit Pal, FCVS and Chairman of CVS Delhi Chapter, recently came into national focus as the Project Director of the Mahi Banswara Rajasthan Atomic Power Project (MBRAPP). On 25th September 2025 the Honourable Prime Minister laid the foundation stone of this greenfield nuclear power project (under a joint venture between NPCIL and NTPC), and dedicated the facility to the nation. On this occasion, Er. Pal spoke extensively on national television channels about the project, its unique features and great potential towards fulfilling India's ambitious nuclear power targets.

Prof. T G Sitharam, FCVS and Chairman – AICTE, is a renowned researcher, educationist and administrator. His excellence as a researcher has again been reaffirmed globally in the recently announce Elsevier – Standford University List of Top 2% Scientists in the world. Despite his significant administrative responsibilities, Prof. Sitharam continues to be actively engaged in the pursuit of scientific research and serves as an inspiration for all engineers and researchers. He was also honoured by CVS with "Eminent Vibration Specialist Award" this year during INVEST-2025 Conference.

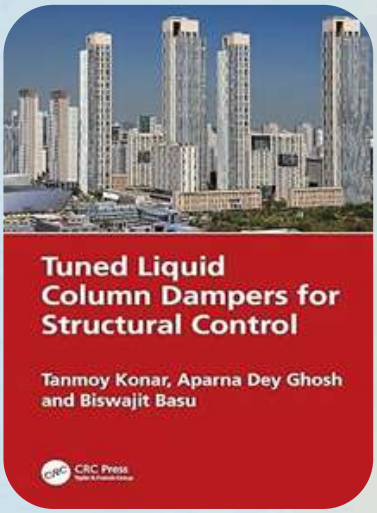
Dr R N Iyengar, FCVS, from Jain University and Ex Director - CBRI, Roorkee. also features prominently in this list (4th consecutive year), along with **Prof. Vasant Matsagar,** Founding Fellow and Director of CVS and Head of Civil Engineering Dept., IIT Delhi,

Er. N P Sundar, FCVS, from Stellar Innostrat Consulting, participated in the Plenary Meeting of ISO/TC 251 at the offices of Standard Norge in Oslo, Norway in May 2025. He is a Member of ISO/TC 251 (through the Bureau of Indian Standards) and is contributing actively to the development of three New Standards/PAS in the domain of Asset Management.

Prof. Dr. Minoru Sasaki, FCVS, from Gifu University – Japan was invited by VelTech (Deemed to be University), Chennai to conduct two intensive short courses during August 2025. As part of the program, Prof. Sasaki delivered expert lectures in his areas of specialization, covering kinematics, dynamics, sensors and intelligent control of robotic systems. He was felicitated by the Institute for his contributions. Prior to this event, Prof. Sasaki also attended the INVEST-2025 Conference at IIT Delhi. He demonstrates abiding interest in various activities of CVS and is a regular participant in CVS events and online programs.

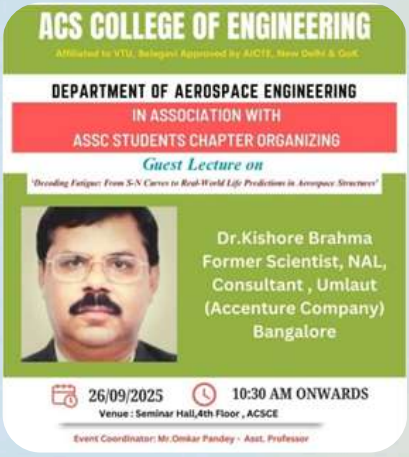
Dr Barun Chakrabarti, FCVS and Editor- amplitude, conducted a series of Rotating Machinery Bootcamps during April – September 2025 across Bengaluru, Mumbai, Pune, Nashik and Sangli, covering critical industrial assets such as Turbines, Compressors and Pumps. As the Skilling Course In-Charge for the SamridDHI Skill-Building Project of Ministry of Heavy Industries, Dr Chakrabarti played a central role developing the contents and delivering the training courses as the Lead Faculty. ModeliCon InfoTech LLP, Bengaluru is the implementation agency for this Project, under the mentorship of Indian Institute of Science (IISc), Bengaluru. So far, over 950 participants from industries and engineering colleges have been trained through these courses.

Prof. Aparna (Dey) Ghosh, CVS Founding Fellow, Professor of Civil Engineering and Dean (Planning & Development) at Indian Institute of Engineering Science & Technology (IIEST) – Shibpur, has authored a book on Tuned Liquid Column Dampers for Structural Control, published by the CRC Press. The book is co-authored by Tanmoy Konar, who also is a CVS Member, and Biswajit Basu.



Dr Tarapada Pyne, Secretary & DG – CVS, participated in the CSIR-SERC Diamond Jubilee Conference on Monitoring, Assessment and Predictive Maintenance of Critical Infrastructure (i-MAP) organised by CSIR – Structural Engineering Research Centre (SERC) at Chennai during 21 – 23 May 2025. Dr Pyne presented an expert talk at this prestigious event and spoke about CVS and its various initiatives. He also interacted with CSIR team and other key participants to explore potential for close collaboration with CVS.

Dr Kishore Brahma, FCVS, Consultant - Umlaut (Accenture Company) and Former Scientist - NAL, delivered a guest lecture at the ACS College of Engineering, Bengaluru on 26th September 2025. The topic of his lecture was "Decoding fatigue: From S-N Curve to Real-World Life Prediction in Aerospace Structures". The event was organised by the Aerospace Department, in association with the ASSC Students Chapter



Dr Rajesh S. Prabhu Gaonkar, FCVS, Professor of Mechanical Engineering at the Goa College of Engineering, has been honoured with the prestigious Frederick W Taylor Award by the Indian Institution of Industrial Engineering (IIIE). The award was given at the 67th National Convention and 9th International Conference of IIIE held at Thiruvananthapuram. The award is in recognition of the accomplishments of Dr Prabhu Gaonkar in promoting Industrial Engineering activities, in addition to his contribution to teaching and research in this field.

Friction Dampers

(Book Preview)

Prof. (Dr.) Suhasini Madhekar, FCVS
Former Professor, College of Engineering, Pune
Prof. (Dr.) Vasant Matsagar, FCVS
Professor & Head, Dept. of Civil Engineering, Indian Institute of Technology, Delhi

1. Introduction

Different types of friction-based devices are used in the vibration response control of structures subjected to dynamic excitations, such as earthquakes. Friction dampers are effective, reliable, and cost-efficient energy dissipation devices. The mitigation of a structure's seismic response is achieved through friction-based energy dissipation, which occurs when two solid plates slide over each other, as shown in Figure 1. The resisting force is generated due to the relative motion of the two plates. Both plates are subjected to a time-varying force F(t) at their ends and a static normal force N perpendicular to the contact surface of the plates.

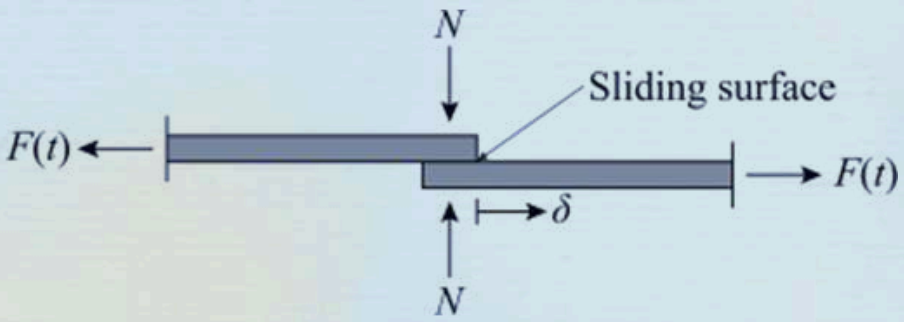


Fig. 1 Friction between two sliding plates in contact

2. Effectiveness of Friction Dampers in Introducing Damping

The effectiveness of friction dampers in providing damping depends on several factors, including the number of devices installed, their placement within the structure, and their physical characteristics. A key parameter influencing a friction damper's performance is the slip load, which determines the amount of energy dissipated by the damper. To maximize energy dissipation, the area under the hysteresis loop should be as large as possible. Figure 2 presents the hysteresis loops of the friction damper for different slip load conditions. If the slip load is very high, as shown in Figure 2 (a), the dampers will not slip even when a very high force is applied to the structure. In this case, the area under the hysteresis loop is very small. Therefore, the energy dissipation is limited, and the dampers are less effective. Similarly, the area under the hysteresis

loop is also very small for a very low slip load, as seen in Figure 2 (b). Consequently, less energy is dissipated, making the dampers less effective. In this scenario, friction dampers will slip immediately when a very low force acts on them, without reducing the response. To achieve maximum response reduction, an optimal slip load must be identified where the area under the hysteresis loop is at its maximum, leading to the greatest energy dissipation. The comparison of energy dissipated by friction dampers against slip load in the three cases is shown graphically in Figure 2.

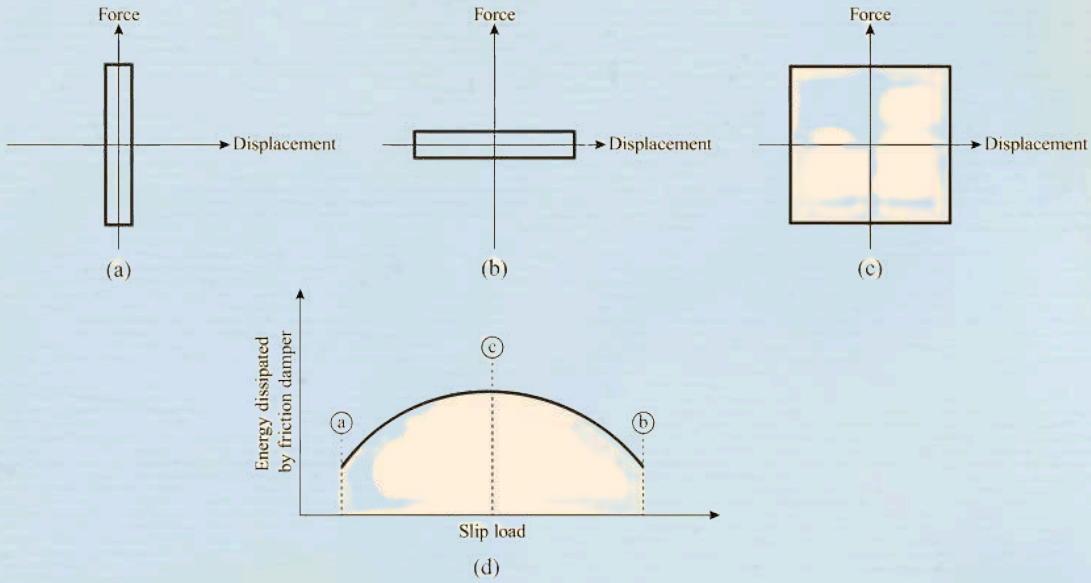


Fig. 2 Comparison of the energy dissipation capacities of hysteresis loops of the friction damper with: (a) very high slip load, (b) very low slip load, (c) optimum slip load, and (d) energy-slip load relationship.

Photo 1(a) shows a Pall friction damper installed in a structure, connected with four links, and Photo 1(b) provides a close-up view of the damper's connection to the joint.

Photo 1. Pall friction damper: (a) structural application and (b) connection of damper to structure. (Heysami 2015)

A friction-damped structure is an engineered structure where the forces exerted by the damper are predetermined. The ability to determine the control force during design is a key technical and economic benefit of friction dampers over fluid viscous dampers. For a fluid viscous damper, the forces could be very large during strong excitations that cause large relative velocities, such as maximum credible earthquakes (MCE). The shape of the hysteresis loop in friction dampers is rectangular, while the force-deformation loop in fluid viscous dampers is elliptical. For a given maximum force, the hysteresis loop area (energy dissipation or damping) of a fluid viscous damper is about 70% of that of a friction damper. The friction mechanism is more effective at dissipating energy than any other method involving steel yielding, yet very few Pall damping devices can achieve substantial energy dissipation. This results in significant cost savings on dampers, bracing, connections, columns, and foundations. While supplemental damping helps reduce earthquake effects and vibration amplitudes, increased rigidity can also be beneficial. Pall friction dampers provide both additional damping and rigidity (due to initial slip load) and are a suitable alternative to fluid viscous dampers, which mainly offer damping.

Friction dampers, such as Pall dampers, are displacement-dependent devices, and their control effectiveness is unaffected by the vibration frequency. Therefore, they are ideal for suppressing vibrations caused by dynamic excitations like earthquakes.

The X-braced Pall friction dampers are designed to operate in tension only. However, the unique configuration of the mechanism ensures that slipping occurs simultaneously in both tension and compression braces. When tension is applied to one of the braces, it causes the damper to slip, which in turn shortens the other (compression) brace, thereby preventing buckling.

Due to lateral load, the compression brace shortens, causing the braking pads to slip before the tension in the brace yields. This activates the friction devices of both braces, which are connected to the four links of the device. To prevent slippage under wind loads, many devices are needed because Pall dampers require a small activation force.

Advantages of Pall Friction Damper

Pall dampers are popular among friction-damping devices because of their simple design, low cost, reliability, and consistent performance. These dampers provide a steady control force during all types of earthquakes. As a result, their hysteresis loop appears as a large rectangle, indicating substantial seismic energy dissipation. Their performance is unaffected by velocity and temperature. Pall friction dampers have been shown to perform satisfactorily during both design-basis earthquakes (DBE) and maximum credible earthquakes (MCE). They remain inactive during service loads and wind, requiring minimal maintenance over the structure's lifespan. Additionally, they are not sacrificial elements and generally do not need repair or replacement after an earthquake. After seismic events, the structure can return nearly to its original position thanks to the restoring action of an elastic component.

Since they contain no fluid components, there is no risk of leakage, unlike fluid viscous dampers, which can leak. Pall dampers are compact and slim enough to be concealed within partitions. They can be installed alongside bracing, including tension cross-bracing and expansion joints. Moreover, Pall friction dampers can be customized to better suit specific site conditions; for example, they can be designed to accommodate foundation settlements.

Application of X-Braced Pall Friction Damper

Due to their high reliability and superior performance, Pall friction dampers have been used in various structures worldwide since 1982. They are employed in both new construction and seismic retrofitting of existing structures. Some notable examples of applications of Pall friction dampers are listed below, where the dampers have proven to be effective, economical, and reliable for seismic protection.

Boeing Factory, United States

The Mammoth Boeing Plant was constructed from 1968 to 1991. It features a steel frame that is 37 m tall and spans 107 m, covering approximately 98 acres of land. An interior view of the Boeing Factory is shown in Photo 2.

Photo 2. Inside view of Boeing Factory, United States. (Pall and Pall 2004)

In 1998, the plant was retrofitted for seismic protection by installing Pall friction dampers in various existing bracing. Adapting to site conditions is a vital aspect of designing different types of dampers. Pall dampers were also used for the seismic retrofit of the Boeing Development Centre, Cafeteria, and Auditorium buildings. Photo 6.4 shows the Boeing Development Centre in the United States, which includes three two-story Boeing development buildings and a four-story building for the cafeteria, auditorium, and

fitness centre. These steel-frame buildings were constructed in 1980. Some of these buildings were damaged during the February 28, 2001, Nisqually earthquake, which had a magnitude of 6.8. The epicentre was approximately 32 km from the site. Due to soil liquefaction, the differential settlements in pile foundations ranged from 0.1 to 0.125 m. This caused significant nonstructural and structural damage to the Cafeteria and Auditorium buildings. The damage was mainly to the rigid steel bracing, with several bracings buckling or cracking severely.

Friction dampers provide damping and stiffness and can be easily modified to fit site conditions. Additionally, they can be designed to accommodate future foundation settlements. As a result, 350 Pall friction dampers were used in the existing steel bracing. The seismic retrofit was completed in 2002. Savings are estimated to be over 60% compared to traditional retrofit methods.

3. Sumitomo Friction Damper

Sumitomo friction dampers, produced by Sumitomo Metal Industries of Japan, were originally used in railway applications. Later, the dampers were adopted in structural engineering to improve the seismic performance of structures. Figure 3 illustrates the assembly of a typical Sumitomo friction damper.

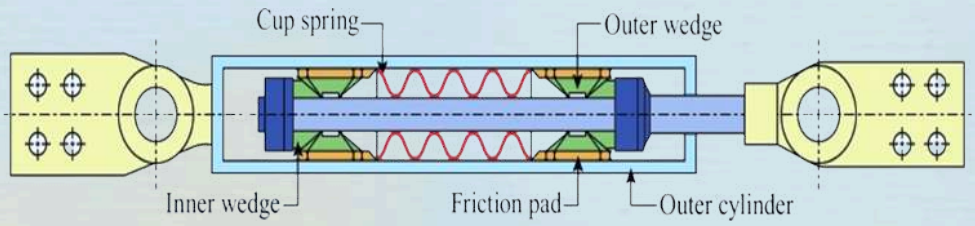


Fig. 3 Assembly of Sumitomo friction damper

The Sumitomo friction damper features friction pads, typically copper infused with graphite, that slide along the cylindrical steel casing of the device. Graphite lubricates the contact surface, ensuring a consistent coefficient of friction between the copper pads and helping the device operate smoothly. A pre-compressed internal spring within the device applies force to the friction pads. This force is converted into a normal force through a set of wedges, which remain compressed due to Belleville washer springs. The steel casing material is chosen to resist corrosion when in contact with copper. Experimental studies by researchers have indicated that a chevron bracing configuration is effective for installing the Sumitomo damper.

4. Constant and Proportional Friction Damper

The ability of a friction damper to reduce a structure's seismic response mainly depends on its hysteresis property, which is affected by the damper's slip force. The constant friction damper (CFD) displays a rectangular hysteresis loop, where the slip force, or friction force, remains constant due to a steady normal force on the slip surfaces. This normal force is generated by either a prestressed bolt mechanism or a prestressed spiral

spring-wedge mechanism. In contrast, the proportional friction damper (PFD) has a slip force that directly relates to the damper's displacement. Its hysteresis loop has a flag-shaped or triangular form. The PFD uses a displacement-dependent normal force to create a proportional damping force, achieved through mechanisms like a spiral spring wedge or a ring spring-wedge. Additionally, the PFD features a self-centring capability. For a given slip force and displacement, CFDs typically dissipate more energy per cycle than PFDs.

5. Pseudo-Viscous Frictional Damper

Pseudo-viscous frictional damper (PVFD) is an energy dissipator developed by combining the advantages of a viscous energy dissipator and a Pall friction damper. Viscous energy dissipators are capable of controlling the acceleration and base shear response without adding any axial pressure to the column. Pall friction dampers perform consistently and reduce the acceleration response even though the compression brace buckles. The construction of PVFD is similar to that of the Pall friction damper. It consists of crisscross plates connected by bolts with four links, as shown in Figure 4.

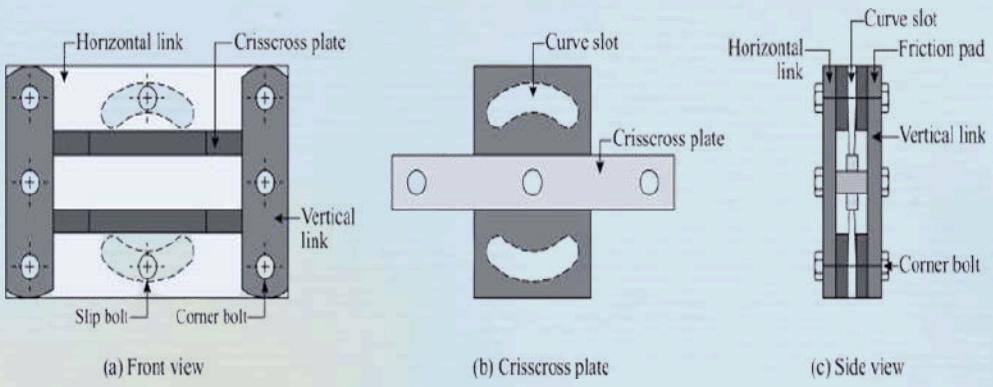


Fig. 4 Pseudo-viscous frictional damper

Two convexities are provided: one on each face of the PVFD, and a brass convexity on the inner face of the horizontal link. In Pall friction dampers, the brass convexity is paired with the flat faces of the crisscross plate and the horizontal links. The initial slip force in the PVFD is generated by the compressive force between the brass convex pad plate and the crisscross plate. This compressive force results from the clip force in the slip bolt. The slip bolt passes through the horizontal link over the brass convexity, brass pad plate, and crisscross plate. The initial slip force is overcome by the PVFD, which deforms as the seismic load reaches its extreme limit. Due to deformation, the brass convexity slides down the crisscross plate's convexity, changing the initial rectangular shape of the PVFD to a rhomboidal shape. This shape change reduces the distance between the convexities and decreases the clip force in the slip bolt. Consequently, atmaximum displacement, the restoring force of the PVFD reaches a minimum, and at zero displacement, it reaches a maximum. Fluid viscous dampers exhibit similar behaviour, which is why it is named PVFD. Figure 5 shows the hysteresis loop of PVFD and the brace to which it is attached.

Advantages of PVFD

PVFDs are easy to produce and quick to install. The friction coefficient of PVFD remains consistent regardless of temperature changes. The dampers efficiently control seismic vibrations. In addition to the base shear, displacement and acceleration responses are also effectively managed.

Limitations of PVFD

PVFDs add extra stiffness to the structure because they provide additional damping. This limits the level of acceleration control compared to other dampers.

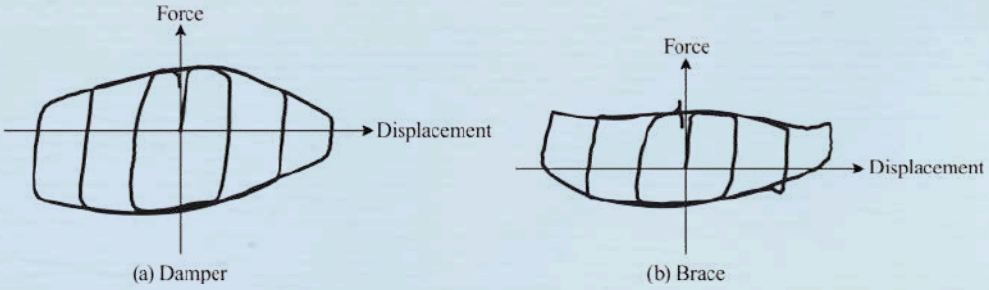


Fig. 5 Hysteresis loop of pseudo-viscous frictional damper

6. Double-Face Frictional Damper

A conventional friction damper consists of a sliding interface that relies on friction and a clamping mechanism to generate a normal contact force on the inner face. To improve the seismic performance of this type of damper, Patil and Jangid (2009) introduced a modified device called the double-face frictional damper. This modification involves adding an extra plate between the two existing plates, as shown in Figure 6. This creates an additional interface, allowing the damper to better resist dynamic forces. It has been reported that, compared to the conventional friction damper, the double-face friction damper offers improved performance in controlling displacement and acceleration, particularly in managing acceleration.

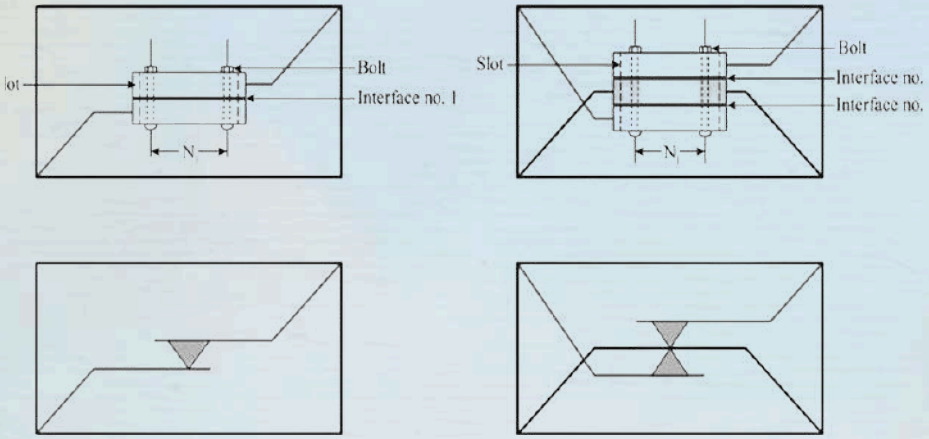
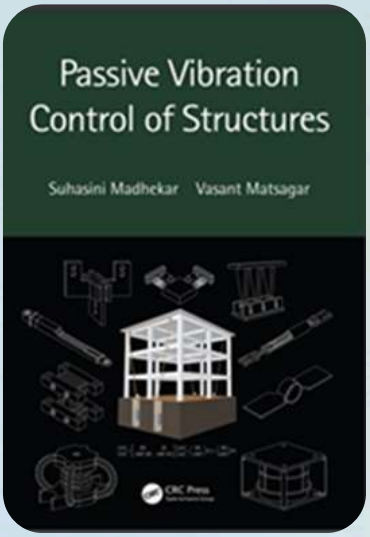


Fig. 6 Schematic and mathematical models of conventional and double friction dampers

Editor's Note : This article is a preview of Chapter-6 of the Authors' book entitled "Passive Vibration Control of Structures" (CRC Press). Chapter-5 was covered in the previous issue of ***"amplitude"***. We plan to present the previews of subsequent Chapters of the book in future issues of this Newsletter.



Need for a Maintenance Plan Design, Strategy & Selection of CBM Techniques

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A. Introduction

Once equipment have been purchased, these must be maintained. The decisions made at the purchasing stage will have an input into the type of maintenance to be carried out. Maintenance actions can be divided into four general categories or strategies. It is important to design a robust system.

B. Maintenance Review, Failure Modes Analysis Plan & Maintenance Strategy Selection

A maintenance review is mandatory to identify potential failure modes. This is done by examining the maintenance records of Asset. Weibull Failure Characteristics & Failure Modes, if performed properly with well-recorded data, can be of great help for the decision-making process of the user during the design or maintenance review to analyze possible and existing modes of failures. After critical reviews, B Factor etc., Maintenance Strategy is formulated and four strategies are integrated:

1) On-Failure Maintenance (Breakdown)
2) FTM - Fixed Time (Planned Maintenance),
3) CBM - Condition Based Maintenance
4) Design-out Maintenance, to monitor Equipment performance in its life cycle.
(Ref Fig 1, 2, 3, 4).

C. CBM - Multiple Techniques & Decision Flow Chart on Overall Setup & its Effectiveness

After selecting CBM as strategy as per Failure Mode, next step is fault detection with most applicable CBM Technique from multiple types and setting up of overall CBM system (Ref: Fig 5, 6 & 7). CBM Flow chart is designed with Five-Step PDCA Cycle Process to evaluate overall CBM effectiveness:

1) CBM Technique, Data Assessment
2) Diagnose, Maintenance
3) Asses Condition Monitoring Organization
4) Asses CBM Techniques suitability
5) Asses CBM Technique Cost Effectiveness at each cycle

Refer to (Fig 5, 6 & 7) for CBM Techniques & Effectiveness Decision Flow Chart.

D. Conclusion & Benefits

If above steps and strategy are formulated with Decision Flow Chart on Overall Maintenance, CBM Setup and Cost Effectiveness, can be well-established without any pitfall. CBM/Maintenance Heads can well justify the application of CBM Techniques and its Gain for Top Management, with successful implementation at Divisions. Author has applied this methodology successfully both as part of Management and as a Consultant.

Fig 1

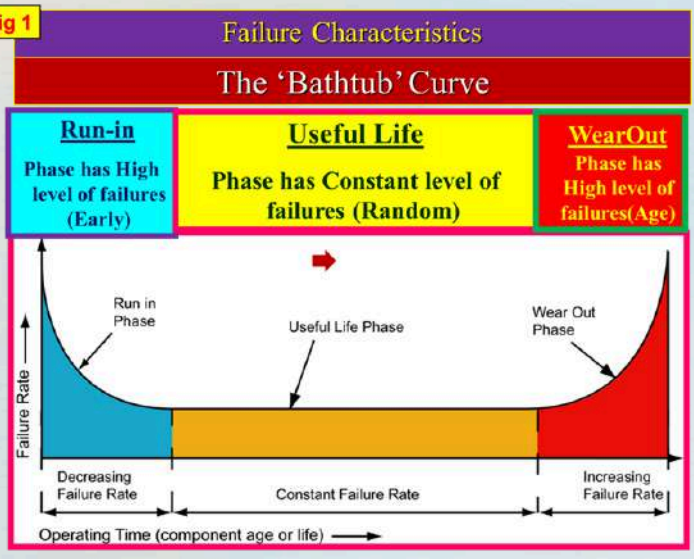


Fig 2

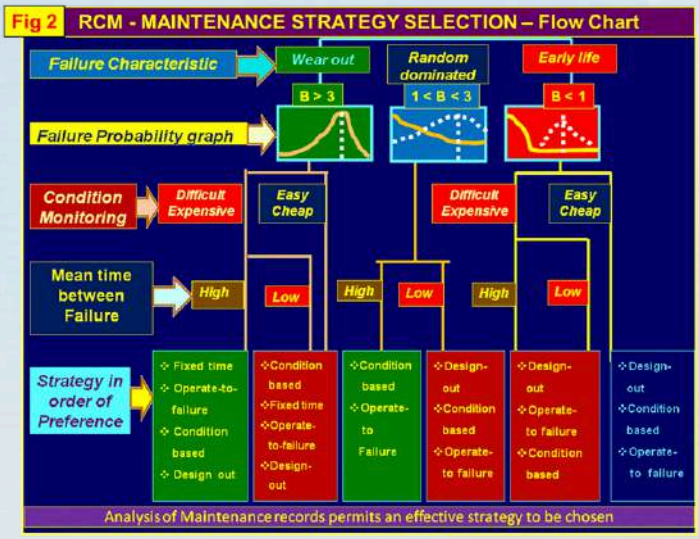


Fig 3

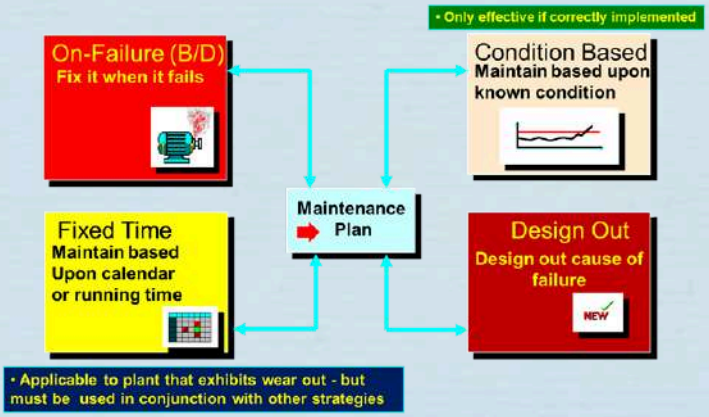


Fig 4

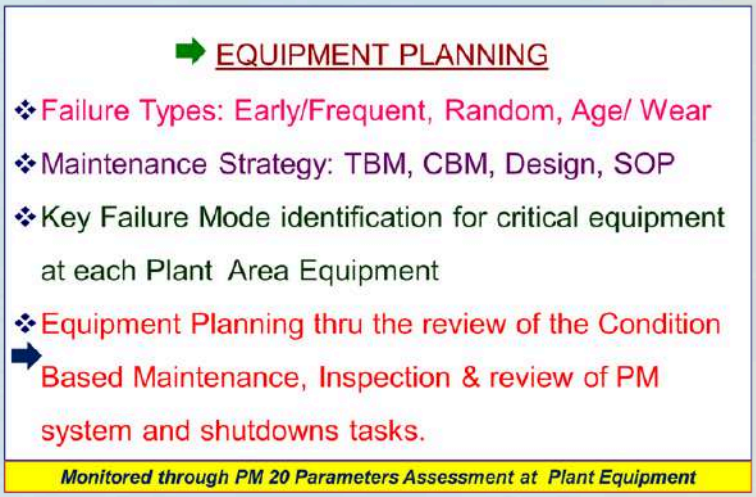


Fig 5

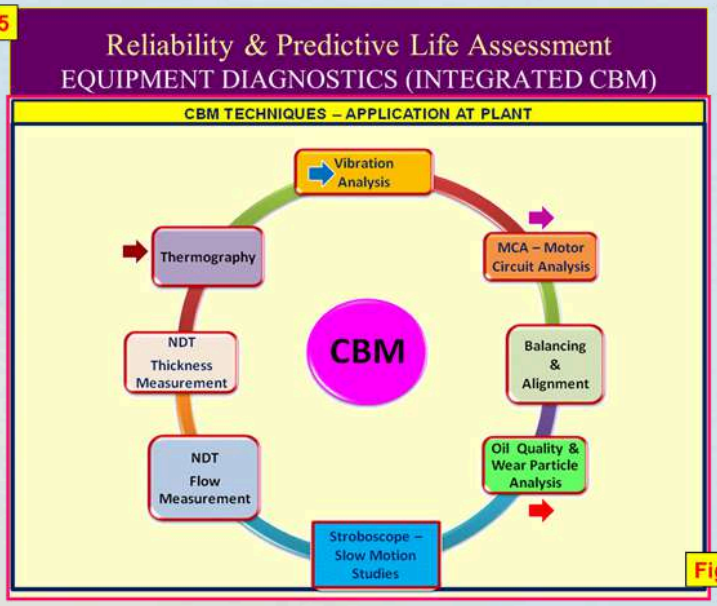
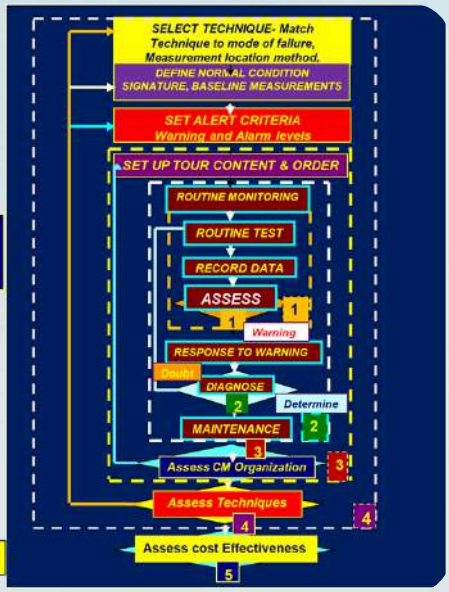


Fig 6

FLOW CHART OF CBM

Fig 7



The CVS Word Game

Contributed by Dr Arun Jalan, FCVS

Let's put on our thinking caps!

C	V	S	C	H	A	I	R	W	O	R	D	G	A	M	E	N	J	O	Y
A	D	V	A	H	I	R	T	O	K	K	A	V	I	C	T	O	R	Y	O
I	S	B	N	S	S	T	U	D	E	N	A	R	U	N	J	A	L	A	N
I	M	E	I	P	R	O	V	N	S	O	O	N	L	I	F	E	A	B	S
H	O	R	N	V	I	B	R	E	H	O	L	W	I	T	H	A	L	L	T
E	M	D	S	H	T	Y	S	P	E	C	I	A	L	F	E	L	L	O	W
Z	S	T	T	P	A	R	I	T	Y	C	O	M	P	E	T	E	N	C	Y
B	E	A	R	X	U	N	A	N	R	E	D	T	P	O	D	E	T	O	M
P	R	O	U	O	U	T	C	I	I	R	B	A	C	R	O	G	R	B	U
I	T	E	C	F	O	R	D	E	N	T	H	A	Y	T	O	P	E	E	M
L	O	T	T	L	O	V	E	C	D	I	E	S	O	N	E	V	M	N	B
A	K	N	O	W	L	E	D	O	U	F	N	X	H	A	S	P	E	G	A
N	A	P	R	O	G	R	A	M	S	I	N	G	P	O	B	R	N	A	I
I	N	E	S	O	U	N	D	P	T	C	N	R	C	E	V	A	D	L	N
V	I	B	R	E	T	O	N	A	R	A	O	O	P	S	R	C	O	U	D
I	N	D	I	A	X	L	E	R	I	T	R	W	A	T	C	T	U	R	I
H	A	P	P	Y	I	P	X	I	E	I	E	T	C	M	A	I	S	U	A
P	R	O	V	I	D	E	R	S	S	O	W	H	K	O	N	C	O	A	T
I	N	V	E	S	T	I	N	O	V	N	D	Y	D	B	H	A	R	A	T
D	E	L	H	I	B	E	P	N	T	R	Y	G	O	O	D	L	U	C	K

Fill in the blanks and find the hidden words

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North (Delhi)	44	7	0	51
West (Mumbai)	57	32	4	93
Overseas	9	2	1	12
Total	165	80	9	254

Category of Membership	Mumbai & West	Bengaluru & South	Kolkata & East	Delhi & North	Overseas
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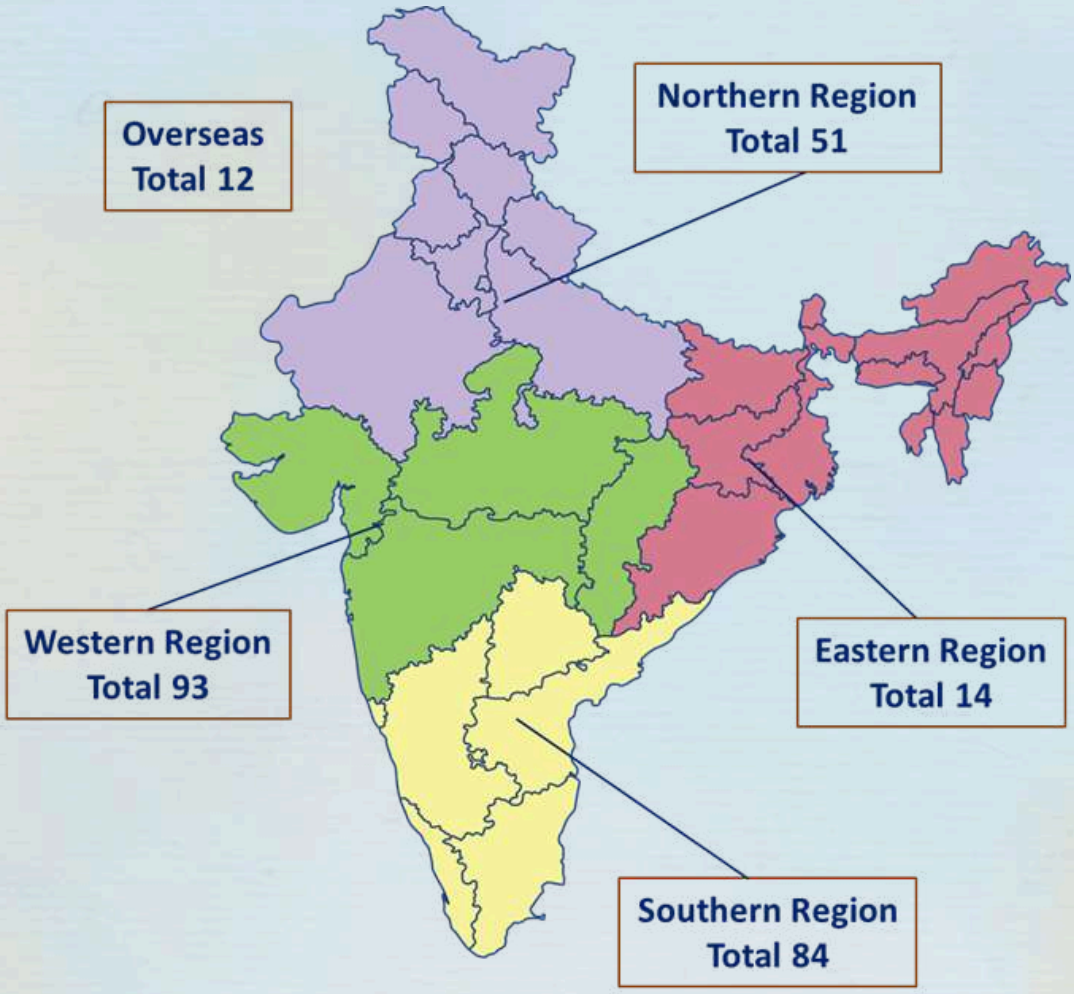
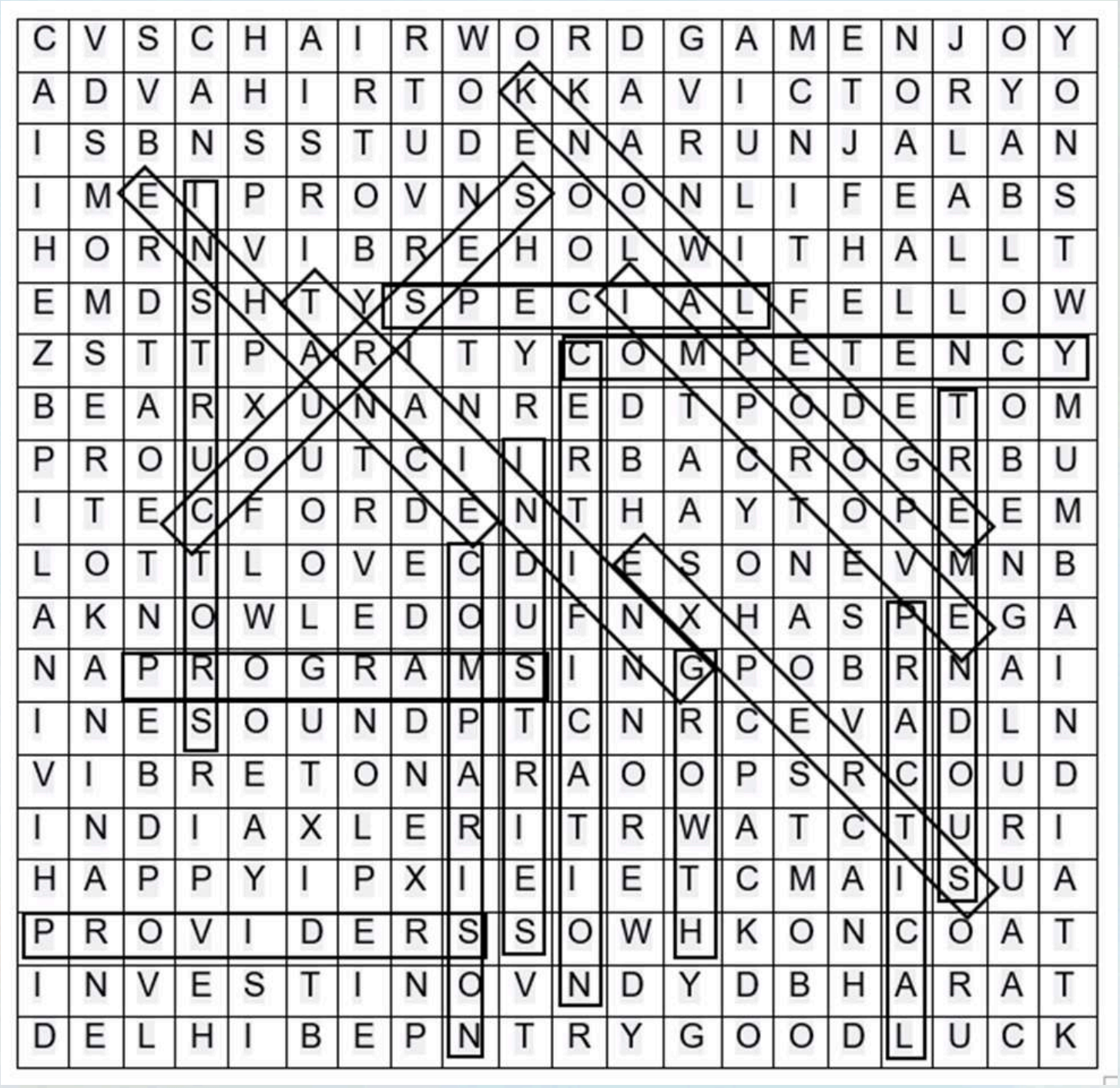
Senior Member	25	14	3	10	3
Member	11	5	2	26	0
Student Member	3	11	0	0	0
Corporate Member	5	4	0	0	0
Total	94	84	14	51	11



Solution to the CVS Word Game



C	V	S	C	H	A	I	R	W	O	R	D	G	A	M	E	N	J	O	Y
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I	M	E	I	P	R	O	V	N	S	O	O	N	L	I	F	E	A	B	S
H	O	R	N	V	I	B	R	E	H	O	L	W	I	T	H	A	L	L	T
E	M	D	S	H	T	Y	S	P	E	C	I	A	L	F	E	L	L	O	W
Z	S	T	T	P	A	R	I	T	Y	C	O	M	P	E	T	E	N	C	Y
B	E	A	R	X	U	N	A	N	R	E	D	T	P	O	D	E	T	O	M
P	R	O	U	O	U	T	C	I	I	R	B	A	C	R	O	G	R	B	U
I	T	E	C	F	O	R	D	E	N	T	H	A	Y	T	O	P	E	E	M
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A	K	N	O	W	L	E	D	O	U	F	N	X	H	A	S	P	E	G	A
N	A	P	R	O	G	R	A	M	S	I	N	G	P	O	B	R	N	A	I
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I	N	D	I	A	X	L	E	R	I	T	R	W	A	T	C	T	U	R	I
H	A	P	P	Y	I	P	X	I	E	I	E	T	C	M	A	I	S	U	A
P	R	O	V	I	D	E	R	S	S	O	W	H	K	O	N	C	O	A	T
I	N	V	E	S	T	I	N	O	V	N	D	Y	D	B	H	A	R	A	T
D	E	L	H	I	B	E	P	N	T	R	Y	G	O	O	D	L	U	C	K

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HYBRID MODULAR MODELLING

This approach breaks complex assemblies into manageable substructures that can be tested and simulated separately. This allows engineers to create accurate system-level models early in development — even before physical prototypes are available.

TRANSFER PATH ANALYSIS (TPA)

Transfer Path Analysis (TPA) methods are various techniques to identify and evaluate the contribution of vibration sources in an assembly. Vibrations and noise levels can be predicted to further understand areas of improvement of the product

SOURCE DESCRIPTIONS

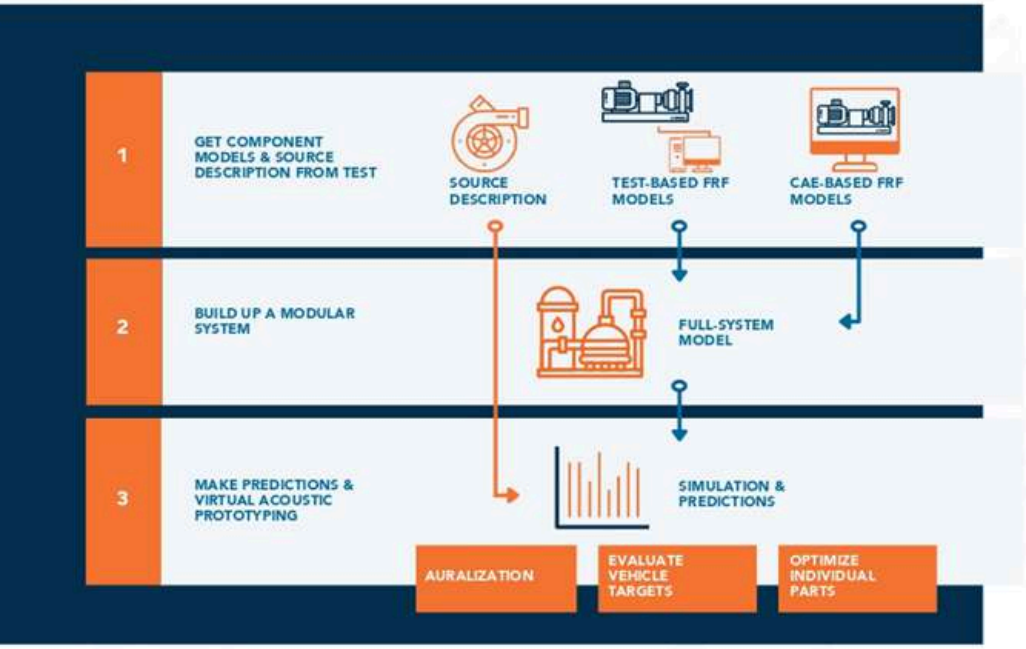
Standardized source descriptions, such as blocked forces, make it possible to characterize active vibration sources independently of the receiving structure. These models can be reused across platforms and integrated into simulations or benchmarking activities.

TEST-BASED MODELLING

When simulation models are not available or not sufficient, test-based modelling allows engineers to build dynamic models of passive components using physical measurement data. These models can be integrated into broader assemblies for NVH analysis.

MODAL ANALYSIS

Modal analysis identifies the natural frequencies, mode shapes, and damping of components or systems. This data supports validation and refinement of structural and acoustic behaviour, particularly in early development stages where accurate models are critical.



INSIDE THE SOLUTIONS

DIRAC

DIRAC enables engineers to prepare, perform and analyse dynamic measurements yielding high quality experimental component models. DIRAC ensures traceability of results and indicates the quality of the measurement. Overall, DIRAC helps to reduce the number of prototype variants needed – thus saving valuable time and resources.

SOURCE

SOURCE is a software tool for Blocked Force Source Characterization (SC) and component Transfer Path Analysis (TPA). It combines all SC and TPA methods in one clear workflow with quality checks. Results are then integrated into CAE simulations, helping engineers address NVH issues early in product development with traceable, reliable data.

COUPLE

COUPLE is a standalone application for assembling, predicting, and improving NVH designs through Dynamic Substructuring. It combines test models from DIRAC and SOURCE with simulation models in a full modular workflow. COUPLE helps avoid late-phase troubleshooting and reduces design cycles, making reliable full-system models available much earlier.

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