amplitude

DIAGNOSTICS & PROGNOSTICS NEWS

2025, Issue - 4

CVS Celebrates
FOUNDATION DAY & REPUBLIC DAY

6Th

77TH REPUBLIC DAY 26TH JANUARY

COUNCIL OF VIBRATION SPECIALISTS

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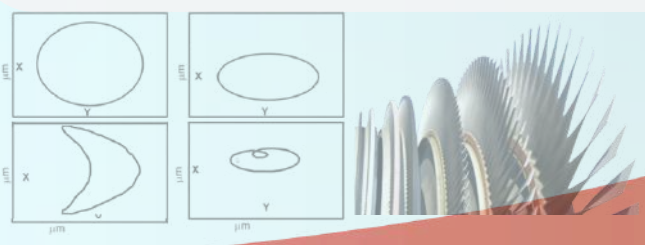

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IRISS
ENGINEERED RELIABILITY

The Game-changing Technology: Motion Amplification

Quick RCA with Real-Time Vibration Visualisation

VIBRATION MONITORING & MOTION ANALYSIS

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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Leading Safety and Reliability

For the people who keep the world running

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.

From the Editor's Desk

Dr Barun Chakrabarti, FCVS

Dear Colleagues,

The Editorial Team of "*amplitude*" wishes all of you and your loved ones a great New Year 2026, full of happiness, good health and fulfilment!

We take pleasure in bringing to you the latest issue of our Newsletter. This is the fourth and final issue for the year ending December-2025.

A new year always brings with it a sense of starting afresh, having new dreams, setting new goals and a fresh bouquet of personal and professional aspirations. The CVS Family should likewise embrace the new year with fresh hopes and commitment to take the organization to greater heights. This issue carries a special message from CVS Headquarters that, I am sure, will resonate with you all. In keeping with this spirit, we now also have a reconstituted Governing Council of CVS and new teams of office bearers at the Local Chapters.

Coming back to the current issue, we present you the latest collection of CVS events and news. The Webinar Series has now been restarted after a brief pause on account of INVEST-2025, and three such sessions were organized in the last quarter. We call upon everyone to use this platform to speak on subjects of your expertise and also attend in large numbers to derive the maximum benefit from this collective learning experience. Please also spare some time to go through the informative technical articles appearing in this issue, on a variety of interesting topics.

We also present a glittering collection of achievements and accolades won of our esteemed members over the past few months. A huge round of applause and best wishes to all of them in their pursuit of excellence.

We invite all Members to come forward and contribute actively to the variety of initiatives and activities – ongoing or to be initiated – within CVS. Be it technical events, seminars, Student Chapter activities, membership drive, contributing to the Newsletter, joining the Chair Committees or promoting the CVS Brand – I am sure there is something of interest for everyone of us. I look forward to the opportunity of closer interactions and engagement with you all in the coming months.

Best regards,

Dr Barun Chakrabarti

New Year Resolutions – 2026

Dr Tarapada Pyne, FCVS
Secretary and Director General

Dear Diagnostic and Prognostic Engineers,

Happy New Year 2026!

We are pleased to release the final issue of ***'amplitude'*** for 2025. Your incredible support propelled our progress throughout the year and made our flagship conference, **INVEST- 2025** at IIT Delhi, a resounding success with nationwide visibility.

The event brought together the entire diagnostics fraternity — well-wishers and passionate specialists in vibration science and allied disciplines. The presence of the Nation's high-profile Honourable Guests, Distinguished Guests, Author-Presenters, Delegates from PSUs, private corporates, R&D laboratories, CSIR, DRDO, Defence Experts, globally renowned Corporate Associates, Keynote and Invited Speakers, and Academia truly enriched the event.

As we step into 2026, we are excited to build on this momentum and work with you to create even more positive outcomes for our diagnostic fraternity. Thank you for being a vital part of the CVS journey. We are now proud to be a community of **over 270 members.**

New Year resolutions often see mixed results — some achieved, others not. Yet, CVS must remain vibrant and dynamic — our inherent strengths. With optimism and perseverance, we continue to pursue our goals. Our core objective is to achieve **self-reliance in Vibration Science and Engineering** and contribute to the nation's urgent skilling needs by bridging knowledge gaps across industry and academia.

We have signed a **Memorandum of Understanding (MoU) with CGSSC, Government of India**, and have progressed significantly in developing training course frameworks. Structured training programs are scheduled to begin in **April 2026** for CGSSC member companies, primarily from heavy industries. CVS is also poised to serve industry by addressing challenges in vibrating machinery — critical, value-adding assets in the manufacturing sector, a major contributor to the nation's GDP. This, indeed, will be a significant contribution towards **"Viksit Bharat."**

CVS is now represented on the **Bureau of Indian Standards (BIS), Sectional Committee MED 28**, which is dedicated to the development and review of vibration standards.

A growing trend within CVS is the continued professional enrichment of our engineers through conferences, seminars, webinars, and peer-to-peer knowledge exchange. Members actively contribute to nation-building by advancing vibration science through training courses, industrial consulting, and by supporting students and faculty in academic projects and research. We urge our members to take time from their busy schedules to mentor students, faculty members, and junior engineers aspiring to build careers in vibration diagnostics.

Modern asset management demands an **interdisciplinary approach** — a message that must be ingrained at all engineering levels. Engineers should recognize and appreciate the need for cross-disciplinary collaboration while addressing asset anomalies. In academia, structured and dedicated programs are essential to nurture the diagnostic community through robust diagnostic education.

With renewed enthusiasm in the new year, CVS remains committed to enhancing individual careers, supporting corporates, assisting higher studies and research, and developing specialized skill-based courses for industry. Active participation from our members (as trainers and contributors) is crucial to achieving the objectives of CVS and elevating the organization's global recognition.

We appeal to all members to actively join **CVS Chair Committees** and contribute to priority areas such as skilling initiatives, course module development, consulting, accreditation of CVS programs, participation in **INVEST 2027**, student mentoring through Chapters, and outreach to academic institutions. The success of CVS depends on the collective support of every member.

A newly elected team is now in place to steer CVS forward, with several members selected based on their interests and expertise. We are confident that under their leadership, CVS will continue to reach new heights.

Key Resolutions for 2026

- Establish closer associations with government bodies, particularly CGSSC, to deliver structured industry-focused training aligned with ISO standards, including new topics on structural and seismic vibration.
- Plan and prepare for **INVEST 2027,** with a strong focus on event management, exhibitions, and increased industry participation.

- Participate in conferences organized by knowledge partners (e.g., **MRAM Expo, Mumbai - October 2026**) and conduct visits to industries and academic campuses to expand membership and open new Chapters.
- Increase CVS membership to **350 members by December 2026**.
- Establish at least **four Student Chapters** and **two Regional Chapters** (Eastern Zone and Hyderabad).
- Conduct **one free webinar every month**, each of **90 minutes** duration.
- Add **three new Corporate Members** and encourage **diagnostic companies to sponsor** physical-mode seminars.
- Enhance the quality and reach of the CVS newsletter, '***amplitude***'.
- Initiate preparations for launching the **CVS Journal**; until then, pursue an MoU with an indexed journal publisher to feature selected INVEST papers, overseen by a dedicated committee.
- Strengthen the activities of the **Training Chair** and **Students Chair** with newly inducted members.
- Encourage CVS members to act as spokespersons promoting CVS training and certification programs, with a focus on **Employability and Skills Development.**
- Conduct regular student programs and industry visits through Student Chapters.
- Continue valuing every member's voice as a knowledge-sharing platform to strengthen the fraternity and expand the reach of vibration science.

As we enter 2026, we are deeply grateful for your unwavering support and dedication. Your passion for vibration diagnostics drives our mission forward. We wish you a New Year filled with renewed purpose, good health, and continued success as we work together toward our shared vision.

Diagnostically yours,
Dr. Tarapada Pyne

Know Our Members

Dr Pravin Hindurao Yadav, SMCVS

Dr. Pravin H. Yadav is Vice Principal and Associate Professor in the Department of Mechatronics Engineering at Vasantdada Patil Pratisthan's College of Engineering and Visual Arts, Mumbai, with over 16 years of academic, administrative, and industrial experience. He holds a Ph.D. in Mechanical Engineering from VIT-AP University (2023), with specialization in fluid–structure interaction, flow-induced vibration, and vortex shedding in finned tube arrays.

He has published 10 international journal papers and 7 conference papers, and holds one granted Australian patent and one Indian patent. He has also secured research funding exceeding ₹31 lakh and has actively undertaken consultancy and industry-supported projects.

Dr. Yadav has played a key leadership role in institutional development, serving as NAAC, NBA, NIRF and AICTE IDEA Lab Coordinator, and has contributed to achieving NAAC 'A' Grade and NBA accreditation for multiple programs. His research interests include vibration, structural dynamics, fluid-structure interaction, composite materials, and outcome-based education.

He is a life member of professional bodies including ISTE, International Association of Engineers, and Council of Vibration Specialists, and continues to contribute actively to academic quality, research, and innovation.

Dr. C. P. Sudheesh Kumar, FCVS

Dr. C. P. Sudheesh Kumar is a Professor in the Department of Mechanical Engineering at Government College of Engineering, Kannur (Kerala), with more than two decades of teaching and research experience. He has been serving the institute since December 2003. He obtained his Ph.D. in Mechanical Engineering from IIT Madras in 2016, M.E. in Aerospace Engineering from the Indian Institute of Science (IISc), Bangalore in 2009, and B.Tech. in Mechanical Engineering from Government College of Engineering, Kannur in 1995.

His areas of research include vibration, acoustics, noise control, and fluid–structure interactions. He has a large body of research publications in reputed international journals and conferences and has actively contributed to vibration and acoustics research. He has also led and completed multiple funded research projects from agencies such as DST-SERB, AICTE, CERD, and RTDC.

Dr. Sudheesh Kumar is actively involved in academic administration and research coordination and has guided Ph.D. and M.Tech. students in advanced areas of vibration, noise, and mechanical system dynamics. He continues to contribute to industry-oriented research, academic development, and collaborative research initiatives.

DR VAMSHI KRISHNA BALLA, FCVS

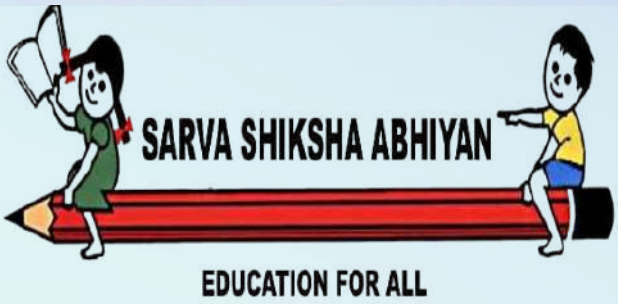
Dr. Vamsi Krishna Balla is heading Noise, Vibration and Harshness group at R&D, TVS Motor Company. Dr. Vamsi is responsible for achieving noise, vibration comfort and regulatory compliance of all motorcycles and three-wheelers using state-of-art simulations and experimental methods. He has a Ph.D. from KU Leuven, Belgium and holds a Master's degree in vibration and acoustics from IIT Madras.

He has over 22 years of experience in dynamic system modelling, simulation, and experimental characterization. In this subject, he has more than 20 international papers and about 40 international patents to his credit and he is an active member of several acoustic and vibration committees.

PROF. GOURAV VIVEK KULKARNI, MCVS

Prof. Gourav Vivek Kulkarni is currently working as Assistant Professor in the Department of Mechanical Engineering, KLS Gogte Institute of Technology, Belagavi. With close to 7 years of Industrial Experience, he is driven by excellent passion towards academics to nurture a task force for the future of a sustainable world. His areas of interest include AI and Neural Networks for vibration problems, composite materials and design optimization.

He was a student member of CVS during his M.Tech. program in Machine Design at RV College of Engineering, Bengaluru and has participated in INVEST-2023 organizing team in IISc and has also successfully conducted Technical Workshops for CVS. He is currently a Life Member of CVS.



DR. JOSEPH J. KAKKASSERY, SMCVS

Dr. Joseph J. Kakkassery holds a B.Tech. in Mechanical Engineering from the Government Engineering College, Thrissur (Kerala), and an M.E. (Aeronautical Engineering) & Ph.D. from the Madras Institute of Technology (MIT), Chennai. With over a decade of experience spanning Research & Development, and academia, he has established strong expertise in advanced engineering systems, structural integrity, and non-destructive testing.

He serves as a Research Faculty at Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai, where he has played a key academic leadership role. From 2019 to 2022, he was the Program Coordinator for the B.Tech. Mechanical Engineering program with specialization in Automobile Engineering, a flagship initiative developed collaboratively by Vel Tech, ARAI, and GARC.

Since 2020, Dr. Joseph has been the Head of the Vel Tech-Dr. Baldev Raj NDT Laboratory, actively promoting NDT education through awareness programs.

In 2022, he additionally assumed the role of Centre Head, High-Speed Bearing Test Facility, leading projects in high-speed rotor-dynamic analysis. He has collaborated with reputed organizations such as GE Aerospace and is currently managing a consultancy project for Hindustan Aeronautics Limited (HAL), reflecting his technical expertise and leadership in advanced aerospace and mechanical engineering domains.

Dr. Joseph J. Kakkassery is an active member of professional societies including the Indian Society for Non-Destructive Testing (ISNT), the American Society for Nondestructive Testing (ASNT), and the American Society of Mechanical Engineers (ASME).

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.

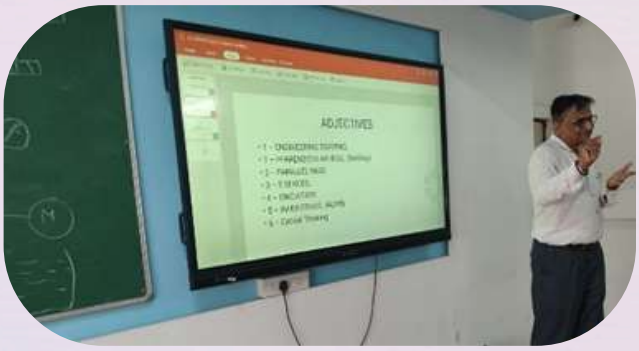
Heartiest Congratulations! We are proud of you.

Dr Nilajkumar N. Deshmukh, FCVS, Dean (Admin & Faculty) and Professor of Mechanical Engineering at Fr. C. Rodrigues Institute of Technology (FCRIT), Navi Mumbai has been elected to the Mechanical Engineering Division Board (MCDB) of The Institution of Engineers (India) at the National Level. Dr Deshmukh is also the Chairman of CVS Mumbai Chapter andthe Chairman, Mechanical Engineering Division of The Institution of Engineers (India)

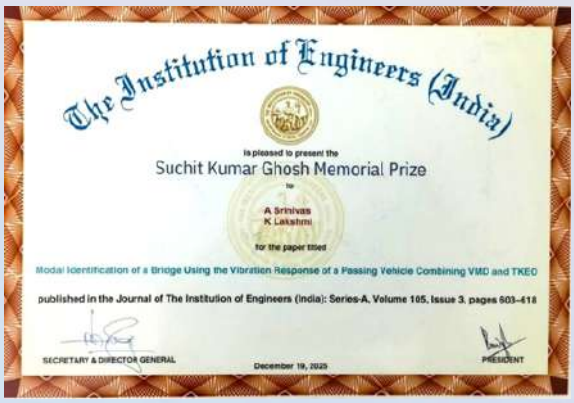
Prof. Amiya R. Mohanty, FCVS, a distinguished faculty member and former Head of the Mechanical Engineering Department at IIT Kharagpur, has been appointed as the BIS Standardization Chair Professor. This prestigious position is established under the recently signed MoU between IIT Kharagpur and the Bureau of Indian Standards (BIS). Prof. Mohanty is a globally renowned expert in Machinery Condition Monitoring and Acoustics. This Chair Professor position recognizes his excellent research contributions, inspirational teaching and service to the profession. Prof. Mohanty has also been recognised as one of the Top 2% Scientists in the prestigious List of Top Scientists published recently by Elsevier and Stanford University.

Er. N. P. Sundar, FCVS, Member – CVS Governing Council and Independent Consultant - Stellar Innostrat Consulting, participated in the Institute of Asset Management (IAM) India Conference 2025 during 10 – 11 December 2025 at Mumbai. He also chaired a Technical Session in which excellent presentations were made by four eminent experts from the industry. Er. Sundar was one of the two faculty members for the development and delivery of a two-day in-person training course on "Documentation, Awareness and Internal Audit of Asset Management System" for BIS-NITS, during 8 – 9 January 2026 at their Noida Facility. The course covered many key aspects of Asset Management and Asset Management System. It was well-attended and also well-received by the participants from various Organizations.

Er. Anoop Saxena, FCVS, Director - AMC Consultancy & Training, participated in the Asset Integrity & Reliability Management (AIRM) 8th Global Conference in Delhi during 17 – 18 December 2025, where he presented a paper and chaired a Session. Er. Saxena also attended the Institute of Asset Management (IAM) India Conference 2025 at Mumbai during 10 – 11 December 2025 and presented a paper. He had previously presented a paper at the National Conference on Condition Monitoring (NCCM – 2025) at Bengaluru during 27 – 28 November 2025, organized jointly by GTRE-DRDO and the Condition Monitoring Society of India (CMSI).



Er. Dilip Patil, MCVS, delivered a guest lecture on "Industrial Aspects of Hydraulics & Pneumatics" on 1st January 2026 at the Jayawant Shikshan Prasarak Mandal's Rajarshi Shahu College of Engineering, Pune. This was organised for the students of the Department of Automation & Robotics. Er. Patil also introduced CVS and its activities to the audience and encouraged the students to become student members.

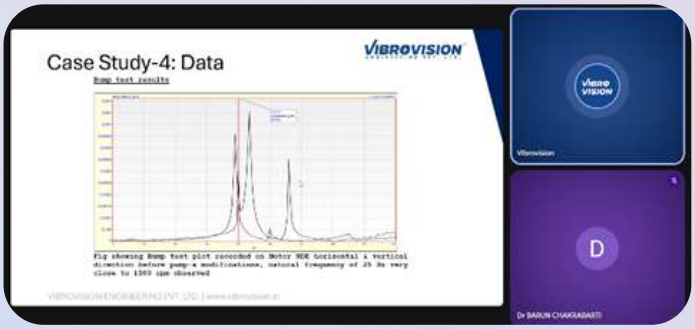


Dr. K. Lakshmi, FCVS, Senior Principal Scientist, CSIR-Structural Engineering Research Centre (CSIR-SERC), Chennai and the Co-author, Mr. A. Srinivas, JRF, CSIR-SERC, have been awarded "Suchit Kumar Ghosh Memorial Prize" by The Institution of Engineers (India), for their paper titled "Modal Identification of a Bridge Using the Vibration Response of a Passing Vehicle Combining VMD and TKEO" (published in the Series A Journal of IEI, Volume 105, Issue 3, September 2024, pp. 603 – 618). The award was presented at the 40th Indian Engineering Congress, held at NIT-Durgapur, during December 19-21, 2025. The award is conferred to the authors, recognizing their publication as the "Best Paper" in the field of Bridge Engineering, published during 2024, in the Series A Journal of IEI.

Vibration Analysis of Industrial Machinery : Few Critical Cases (12 October 2025)

Er. Kunal Sharma SMCVS
Director - Vibrovision Engineering Pvt. Ltd.

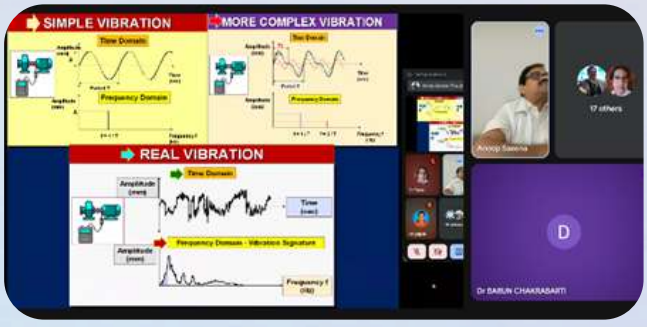
Er. Kunal Sharma presented an overview of vibration analysis for critical machinery through a set of interesting case studies. The session started with basic concepts of vibration measurements and analysis, followed by discussion on four examples of vibration troubleshooting across industries. Key fault conditions covered in the talk included: balancing of motor rotor, misalignment in motor-pump assembly, looseness in a blower and resonant vibration in a motor-pump system. A structured Root Cause Analysis approach was presented for all the cases. The talk concluded with a summary of step-wise diagnostic approach that can effectively be used in troubleshooting machinery vibration problems.

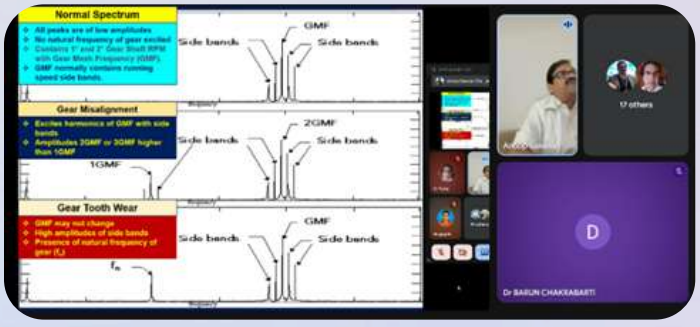


SIMPLIFYING VIBRATION ANALYSIS: USER-FRIENDLY TIPS FOR BETTER PROBLEM SOLVING (16 NOVEMBER 2025)

ER. ANOOP SAXENA, FCVS
EX SR. VP - USHA MARTIN, TECHNICAL HEAD - SUPER SMELTER,
AGM - JSPL, DIRECTOR – AMC CONSULTANCY & TRAINING

Er. Anoop Saxena presented a lucid introduction to vibration characteristics, key diagnostic approaches and need for predictive skills in successful troubleshooting. He offered many practical tips based on field experience across plants and industry sectors. The talk covered an overview of monitoring systems, measurement tips, common machinery defects and corresponding symptoms, frequency analysis technique and Ratio Analysis. Several case studies were presented to illustrate the application of these concepts. These included: fan unbalance, blower misalignment and fault diagnosis for rolling element bearings and gears. The talk was followed by a lively Q&A session.

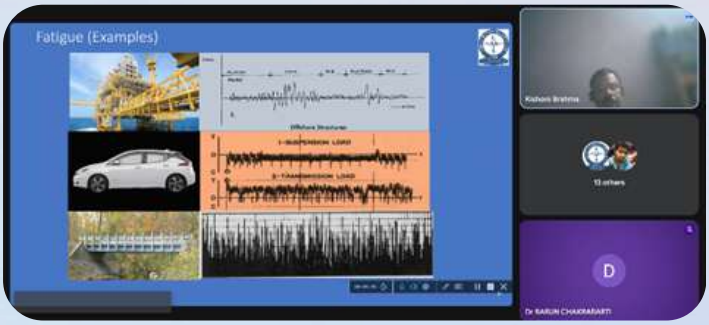


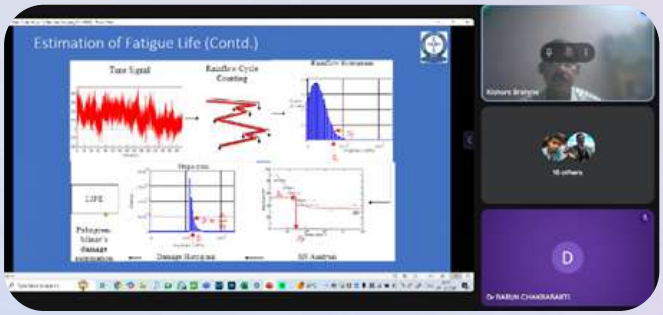


Rainflow-Based Damage Prediction: Modern Techniques for Vibration Fatigue Life Estimation (07 December 2025)

DR. KISHORE BRAHMA, FCVS
SENIOR ADVISOR - STRUCTURAL ANALYSIS AND ASSET LIFE ASSESSMENT
(AEROSPACE & MECHANICAL)

Dr. Kishore Brahma presented his talk in two parts. The first part covered the fundamental aspects of Fatigue phenomenon, covering S-N Curve, Fatigue Life, Damage Summation Method and the Cycle Counting Technique. The concept of Static Strength vs Fatigue Strength was clarified. The 3-stage fatigue failure process was explained and classical approach in terms of the Miner's Rule and Plamer-Miner Rule was presented. The second part was primarily on Random Vibration Fatigue, in terms of fatigue life estimation, random vibration loading history, PSD of vibration excitation and response in terms of acceleration and stress. The talk concluded with an overview of Rain Flow Cycle Counting technique and Cumulative Damage Calculation, with examples of typical fatigue life results for aerospace application.





Metallic 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

Civil structures often face various dynamic and environmental loads, such as wind, traffic, and earthquakes. In particular, earthquakes can cause significant damage to buildings. To prevent or mitigate such damage, various structural vibration control techniques have been developed and effectively applied across multiple structures. Passive hysteretic devices are classified into metallic and friction dampers, which dissipate energy independently of the loading rate. Metallic dampers absorb energy through inelastic deformation of their materials. These dampers display stable hysteretic behaviour, are rate-independent, and remain unaffected by temperature changes. Additionally, they are reliable and provide an economical and efficient way to dissipate energy through metal yielding. When examining yielding metallic dampers, many factors are typically considered, including strength, stiffness, total energy absorption, damping ratio, fatigue strength, deformation capacity, energy-to-weight ratio, force-to-weight ratio, and construction cost. Photo 1 shows metallic dampers installed in buildings, while Photo 2 displays various types of metallic dampers used for different applications.

Photo 1. Metallic dampers installed in a building

Photo 2. Various types of metallic dampers

2. X-Shaped Metallic Damper (ADAS DEVICE)

The conventional bracing system may not sufficiently reduce dynamic loads. Adding damping and stiffness (ADAS) dampers is highly recommended, especially in moment-resisting frames and chevron bracing systems in concrete and steel frames, to improve damping and stiffness in structures. The X-type metal damper setup is often used alongside traditional bracing. ADAS dampers display stable hysteretic behaviour, high lateral stiffness, significant damping, long-term reliability, and easy integration into structures. An ADAS damper consists of X-shaped steel plates connected in parallel to a base plate with bolted joints. Figure 1 shows a typical X-shaped (ADAS) damper, also called an X-plate metallic damper.

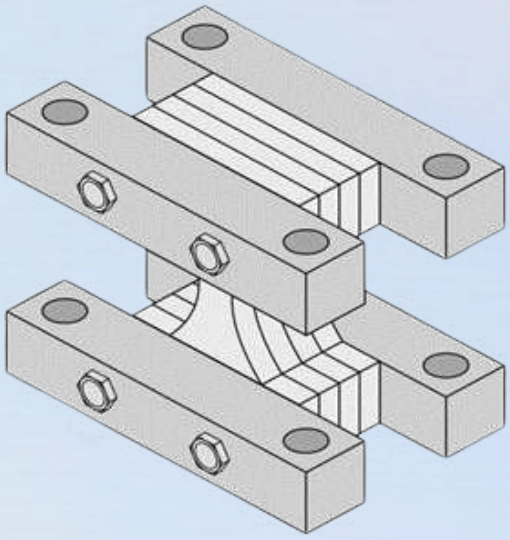


Fig. 1. An X-shaped added damping and added stiffness damper

3. Tyler's Yielding Steel Bracing System

Inelastic deformation of metals effectively absorbs energy. Traditionally, seismic-resistant design of structures relies on the ductility of structural members to absorb energy from dynamic excitations. To enhance the seismic performance of concentrically braced frames, specially designed buckling-restrained braces (BRBs) are used. However, the core of the BRB, which extends beyond its sleeve, is prone to buckling and eventual fracturing at its ends, as shown in Photo 3. This can lead to connection failure. As a result, the ductility and energy dissipation capacities of BRBs are not fully utilised.

Photo 3. Out-of-plane buckling of the gusset plate of the BRB connection

To ensure the efficient use of ductility and energy dissipation capacity, a steel-yielding brace system (YBS) has been developed. It is a highly ductile brace frame that can serve as an alternative to BRB. Additionally, a YBS has a high potential to provide a stiffer structure with greater ductility. The YBS is a highly elastic, stiffened lateral force-resisting system with a complete and symmetrical hysteresis loop, characterised by an increase in post-yield strength at large drifts. In seismic design, controlling peak lateral displacement during the design basis earthquake (DBE) is crucial. Under DBE, a system with high elastic stiffness performs well because it relies on the equal displacement approximation. At large drifts, increased post-yield strength helps prevent potential collapse. Inelastic deformations tend to concentrate in one story of a building where YBS with low post-yield stiffness is installed. This can lead to premature collapse, localised in a single story, due to increased concentration of elastic deformation. YBSs are generally provided alongside ADAS devices to enhance the seismic stability of structures. In structural design, bracing members are considered rigid and provide significant stiffness. When ADAS devices are employed with the YBS, they are designed to reduce column shear forces drastically. Figure 2 illustrates the steel YBS mechanism.

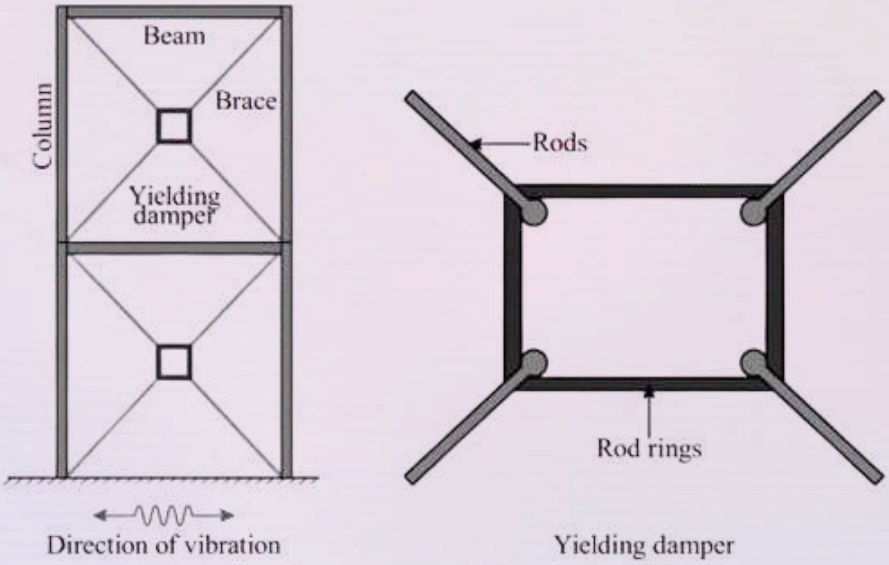


Fig. 2 Yielding brace system.

4. Cast Steel Yielding Brace

The cast steel YBS is a hysteretic damper developed at the University of Toronto to improve the seismic performance of braced frames. As shown in Photo 4, this system uses a cast steel connector to absorb seismic energy through the inelastic flexural yielding of triangular fingers. The device prevents the tensile yielding and inelastic buckling of traditional braces. Additionally, the damper produces a symmetrical hysteresis loop with increased energy dissipation, and the hysteresis loop of the cast steel YBS is shown in Figure 3.

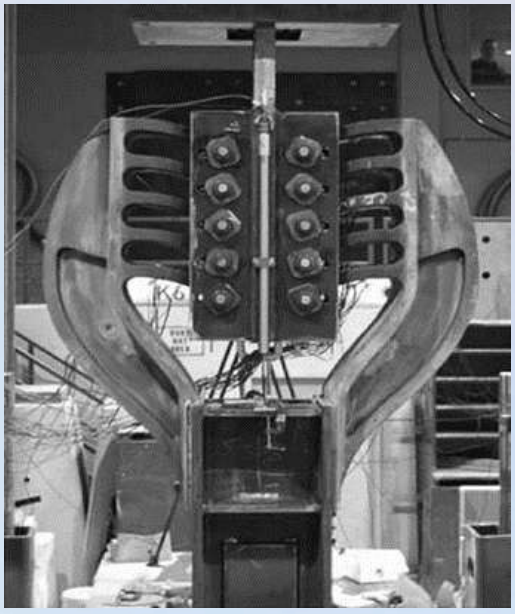


Photo 4. Cast steel yielding brace system (YBS)

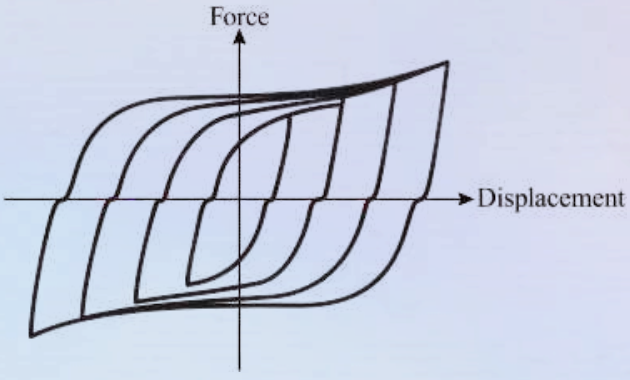


Fig.3 Hysteresis loop of cast steel

5. Steel Damper

Steel dampers are made from mild steel plates in various shapes, such as straight, concave, or convex. The resisting force they generate is proportional to displacement. The specimen with a convex shape exhibits stable hysteretic behaviour with effective energy dissipation and ductility. Metallic dampers can absorb significant input energy due to steel's hysteresis behaviour. As shown in Figure 4, hysteretic energy is dissipated through: (i) axial yielding of steel braces or BRBs, (ii) flexural yielding of the ADAS or triangular-plate ADAS (TADAS) devices, or (iii) shear yielding of shear links or link beams.

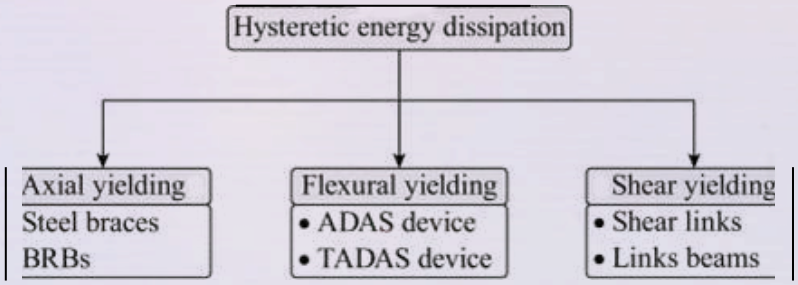


Fig. 4. Dissipation of hysteretic energy

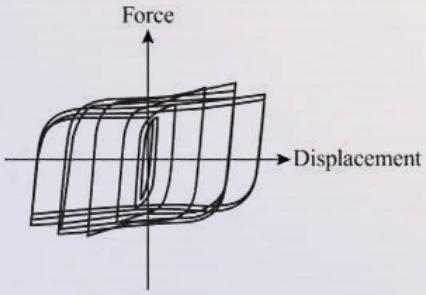


Fig.5 Hysteresis loop of shear yielding damper

The steel damper demonstrates stable hysteretic behaviour, long-term reliability, and easy integration into structures. Commonly used types include bar-type, loop-type, portal-type, ring-type, and plate-type steel dampers. Figure 5 illustrates the hysteresis loop of a shear-yielding damper.

6. Bar-Type Steel Damper

Bar dampers are mainly designed for installation as beam-column connections at building frame corners. A bar-type steel damper consists of several solid steel bars arranged both horizontally and vertically, as shown in Figure 6. The horizontal bars attached to the column in the structural frame dissipate seismic energy through flexural yielding, while the vertical bars attached to the bottom of the beam dissipate energy via axial and shear yielding. As depicted in Figure 6, the ends of the vertical bars are welded to the top and bottom plates to ensure rigidity, and the horizontal bars connected to the column are secured with bolted connections. The damper may fail under cyclic loading because the back-and-forth movement generates large axial compressive forces in the bars. Due to cyclic loading, the mechanical properties of the bar damper, such as energy dissipation rate, stiffness, and strength, can significantly deteriorate. The parallel steel bars share common end support conditions.

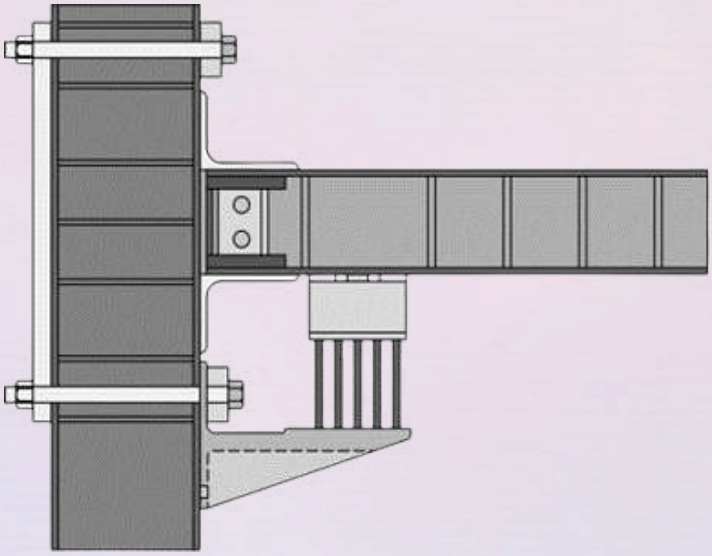


Fig. 6. Bar-type damper installed in a frame

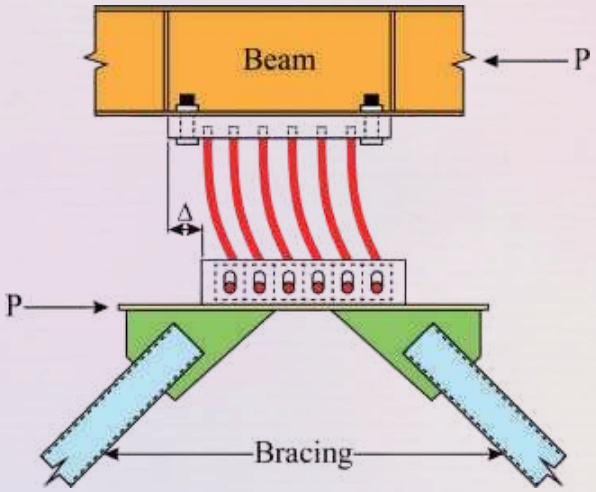


Fig. 7. Bar damper connected to bracing system

When a horizontal deformation is applied to the frame by force P, each solid bar of the damper experiences an in-plane shear force, as shown in Figure 7, dissipating seismic energy through flexural yielding. The primary advantage of a bar damper is that it is an affordable, metallic damping system made from ordinary steel without complicated assembly techniques. Therefore, the damper is widely used in practice.

7. Portal-Type Steel Damper

Steel-curved dampers are used to improve the seismic performance of portal frame structures. These dampers are effective in strengthening portal frames. They are attached to frames with steel plate hinges, as needed, and are designed for specific shapes. Additionally, the dampers are placed at equal distances from the frame's centre and the loading axis. Steel-curved dampers can easily bend under external loads. Their early yielding helps limit seismic damage to structural members. These dampers can be installed at various angles: 30°, 60°, 90°, and 120° between their ends in pitched roof, symmetric, and mono-pitch portal frames. In countries where steel is expensive and large sections are hard to find, providing built-up sections or increasing member size is not practical. Moreover, in earthquake-prone areas, reducing structural weight is crucial for significantly reducing earthquake-induced inertial forces. Using steel-curved dampers in such cases can lead to significant savings in structural weight. However, portal-type steel dampers are not suitable for long-span portal frames, like industrial buildings and hangars. Figure 8 shows the steel-curved damper attached to the portal frame, and Figure 9 illustrates the mono-pitch portal frame with steel-curved dampers.

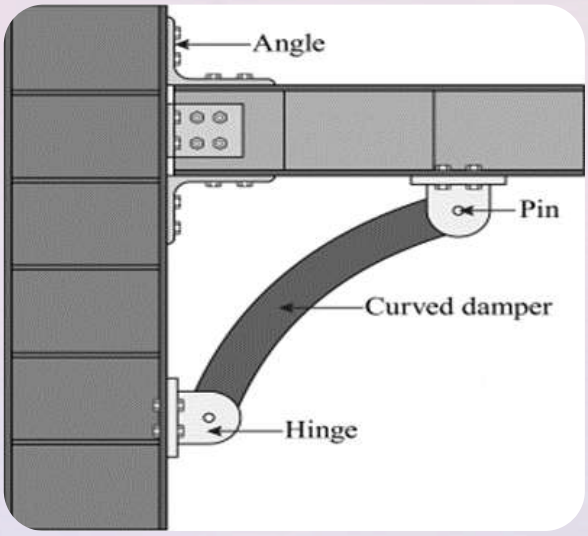


Fig. 8. Steel-curved damper attached to a portal frame

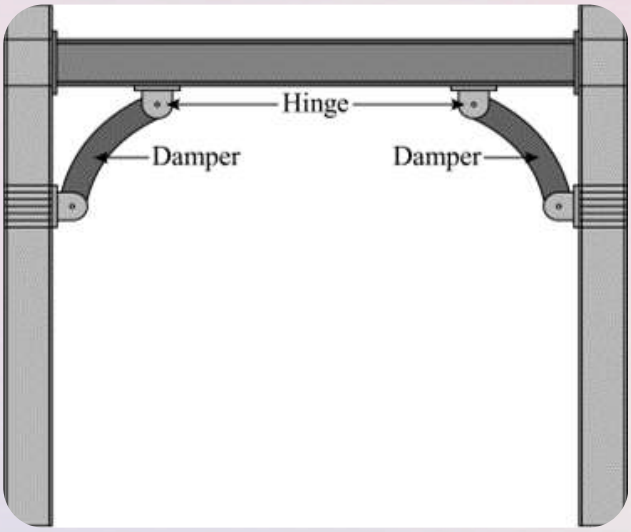


Fig. 9. Mono-pitch portal equipped with steel-curved dampers

8. Dual-Pipe Damper and Infilled-Pipe Damper

The dual-pipe damper consists of two pipes welded at specific points, as shown in Photo 5. Its energy dissipation mechanism operates through the flexural yielding of the pipes. During significant lateral displacement, the damper experiences tension, which enhances its stiffness and strength. Compared to single-pipe dampers, double-pipe dampers are more effective. It is reported that these dampers exhibit satisfactory ductility, energy absorption capacity, and stable hysteresis loops during quasi-static cyclic tests. Figure 10 shows the hysteresis loop of a double-pipe damper.

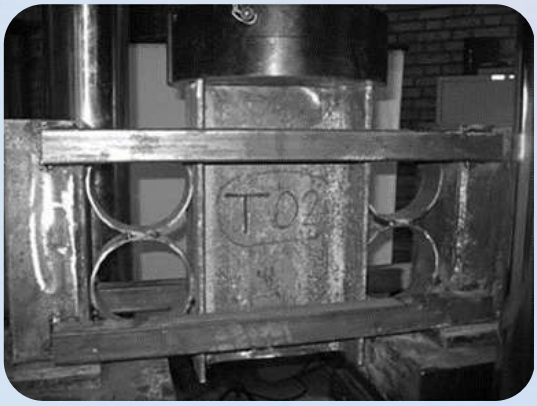


Photo 5. Dual-Pipe damper

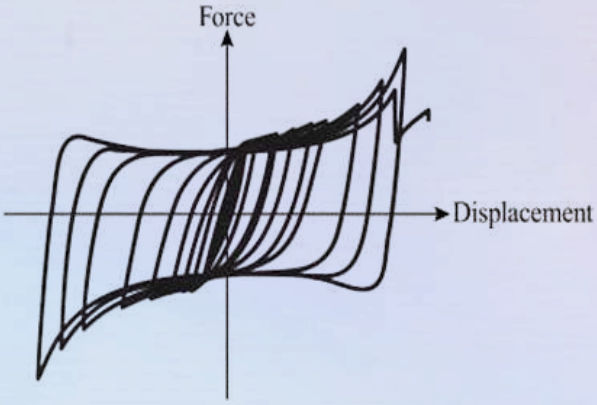


Fig. 10. Hysteresis loop of double-pipe damper

The infilled-pipe damper is made of two welded pipes with smaller pipes inside, as shown in Photo 6. The space between the pipes is filled with metals such as lead or zinc. The energy dissipation mechanism in the device includes: (i) plastification of the outer pipes, inner pipes, and infilled metal, and (ii) friction between the metals.

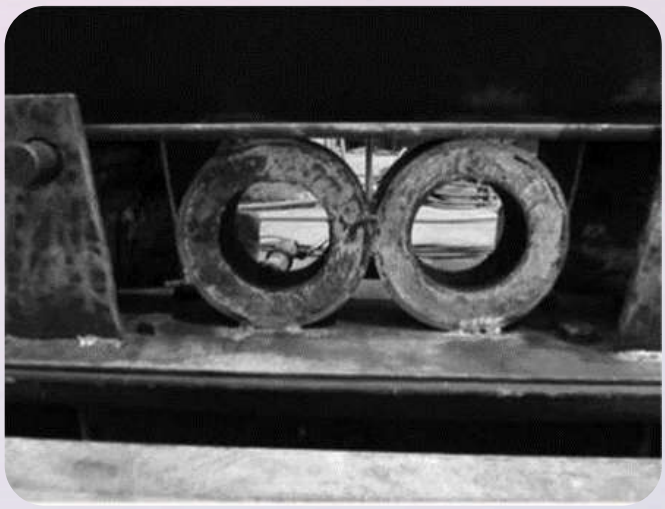


Photo 6. Infilled-pipe damper

9. Triangular Metallic Damper

The performance of tall, slender, and flexible buildings remains a concern for researchers and structural designers because of the large inter-story deformations caused by dynamic excitations. Response control devices with stable force-displacement relationships and high energy dissipation capacity are suitable for reducing the undesirable response of such structures. A steel triangular added damping and added stiffness (TADAS) device is an economical energy-dissipation solution to improve the earthquake performance of these structures. TADAS exhibits the necessary elastoplastic constitutive behaviour, which is a common feature of metallic dampers. The TADAS device consists of several triangular plates welded to a common base plate, as shown in Figure 11 (a). The device primarily uses mild steel plates, although copper and stainless-steel versions have also been developed. Due to the low cost and simple manufacturing process of mild steel, TADAS made from mild steel is preferred. A significant amount of heat is generated during the manufacturing of TADAS when welding the plates. A special heat treatment is necessary to relieve the residual stresses developed during this process.

Experimental results show that TADAS can withstand numerous yielding reversals without losing stiffness or strength. Figure 11 (b) displays the force-displacement loop of the TADAS device.

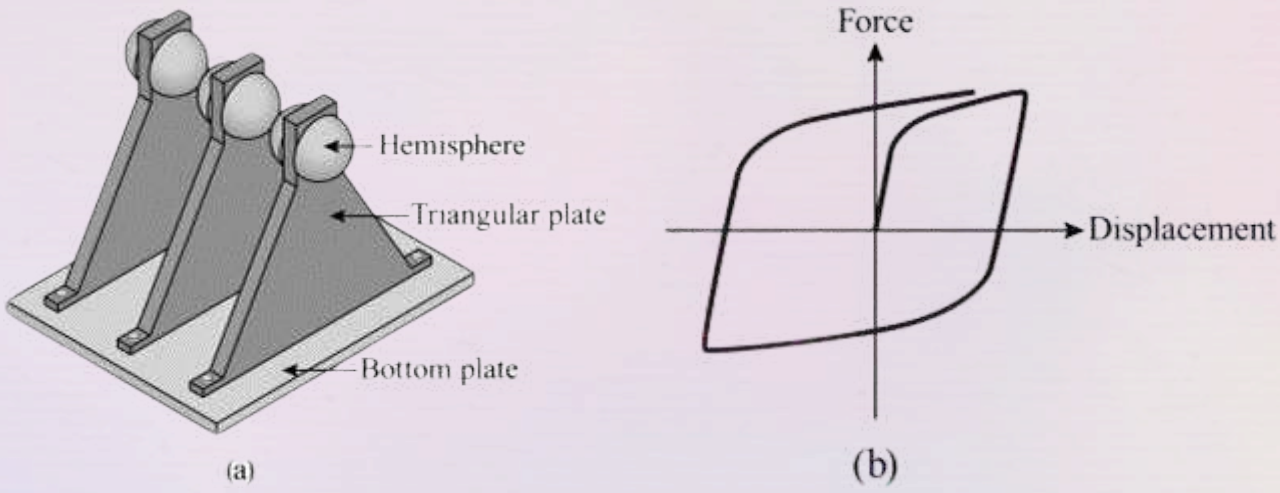


Fig. 11. Schematic diagram and hysteretic loop of a TADAS device
(a) Schematic and (b) hysteresis loop

One end of the TADAS device is fixed to the structure, and the other end is pinned. The pinned end generates smaller axial forces in the TADAS dampers. Both ends of the ADAS devices or shear panels are fixed, which results in larger axial forces. Therefore, TADAS are preferred over ADAS and shear panels.

Photo 7 displays the TADAS device installed on the test machine. Figure 12 (a) shows the welded connection details of the TADAS device, and Figure 12 (b) depicts an individual steel triangular plate. TADAS dampers can also be made with PTFE sliding plates inside the steel block.

Photo 7. TADAS devices installed in the test machine.

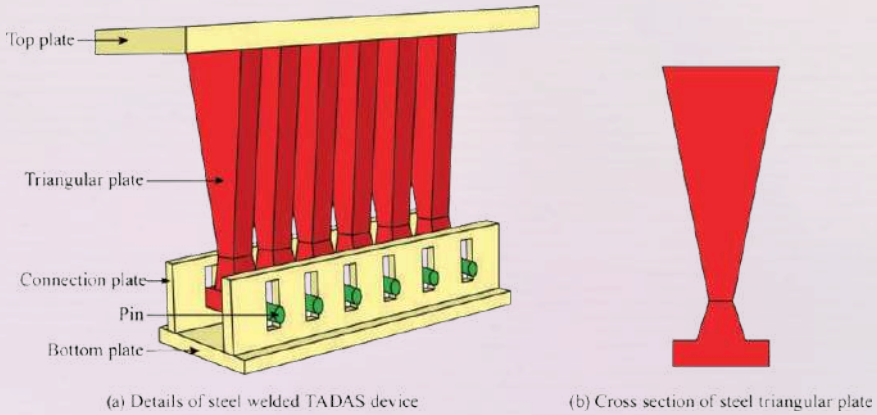


Fig. 12. Triangular-plate added damping and added stiffness device: (a) details of the steel-welded TADAS device and (b) the steel triangular plate

10. Strip Metallic Damper

Figure 13 shows a strip metallic damper and its hysteresis loop. The loop reveals that the damper has high initial stiffness, strong deformability, and efficient energy dissipation. It is important to note that a small vertical load can cause significant deformation of the entire system, leading to instability. Due to out-of-plane buckling in the strip area, the strength of the damper decreases suddenly.

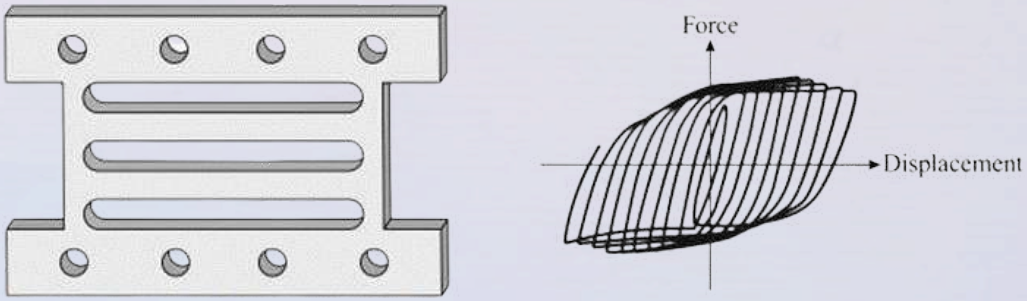
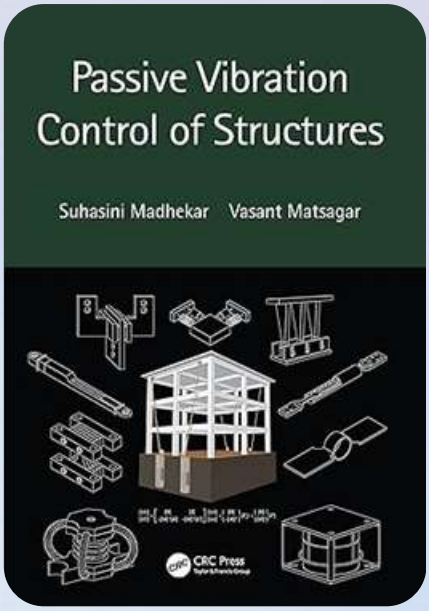


Fig. 13. Strip metallic damper and its hysteresis loop

Editor's Note

This article is a preview of Chapter-7 of the Authors' book entitled "Passive Vibration Control of Structures" (CRC Press). Chapter-6 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.



Experimental investigation of fracture orientation effects on bone dynamics behavior through vibration analysis

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ABSTRACT

Conventional diagnostic tools for identifying fractures in bone, like X-rays and CT scans, are widely used, but involve ionizing radiation and lack sensitivity to physical degradation, like stiffness loss and damping in bones. To overcome these limitations, non-invasive vibration-based diagnostic techniques are emerging as promising alternatives for evaluating fracture severity. This work aimed to assess the dynamic behavior of bone specimens with varying fracture orientations specifically oblique, longitudinal, and lateral to identify which orientation leads to the most severe mechanical degradation. Goat metacarpal bones were tested with four fracture types with an unfractured reference bone. Controlled lateral impacts were applied using an instrumented hammer, and vibrational responses were recorded using an accelerometer. Data were analyzed using Fast Fourier Transform (FFT) to extract Frequency Response Functions (FRF), coherence, and phase characteristics. Each condition was subjected to three tests for consistencies in results. The results indicated that lateral fractures resulted in the greatest decrease in stiffness, lowest resonance frequency, and largest FRF magnitude, making them the worst fracture type in mechanical degradation. This method has implications for radiation-free fracture diagnosis, particularly of benefit to pregnant women and radiation-sensitive groups. The experimental investigation was conducted on goat metacarpal bones under controlled laboratory conditions. Five specimens were examined: one intact reference bone and four artificially fractured bones with different fracture orientations—lateral (perpendicular to the bone axis), longitudinal (parallel to the axis), and two oblique fractures at 45° (left-to-right and right-to-left). Controlled low-velocity lateral impacts were applied using an instrumented impact hammer, and the vibrational response was measured using an accelerometer mounted near the fixed end of the specimen. Signals were acquired through a DAQ system and processed using FFT-based methods to obtain Frequency Response Functions (FRF), coherence, and phase characteristics. Each test condition was repeated three times to ensure measurement consistency and reliability.

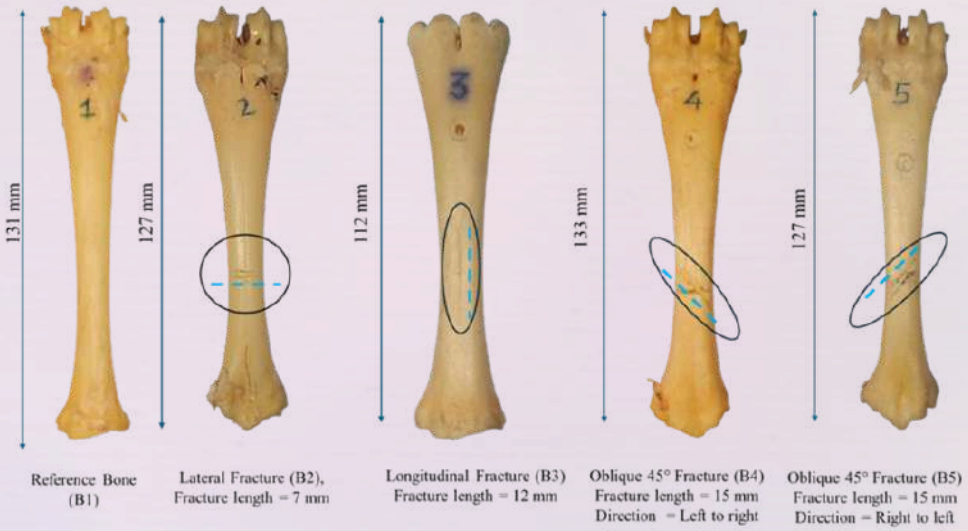

Figure 1. Fracture orientations on bone

The frequency-domain analysis revealed that fracture orientation has a pronounced influence on bone dynamic behavior. The intact bone exhibited stable vibrational characteristics with a resonance frequency around 62 Hz, high coherence values close to unity, and smooth phase transitions, indicating preserved stiffness and linear system behavior. In contrast, the lateral fracture showed the most severe mechanical degradation, characterized by a drastic reduction in resonance frequency to approximately 14 Hz and an increased FRF peak magnitude. This response reflects significant stiffness loss and altered damping behavior due to fracture-induced discontinuities. The coherence drop and irregular phase transitions near resonance further confirmed nonlinear energy dissipation mechanisms associated with the lateral fracture.

Longitudinal fractures demonstrated comparatively mild effects on dynamic response. The resonance frequency shifted to a higher range (around 251 Hz) with a lower FRF magnitude, suggesting that stiffness was largely preserved due to the fracture alignment being parallel to the force transmission path. Oblique fractures exhibited intermediate behavior, with mixed stiffness degradation and damping effects. Notably, the right-to-left oblique fracture showed high FRF magnitudes at resonance, indicating unstable vibrational energy transmission and localized fracture interface interaction.

Overall, the results confirm that lateral fractures induce the greatest loss of mechanical integrity, followed by oblique fractures, while longitudinal fractures are mechanically less severe under transverse excitation. The study demonstrates that vibration-based FRF analysis can effectively differentiate fracture severity based on measurable dynamic parameters such as resonance frequency, FRF magnitude, coherence, and phase shift.

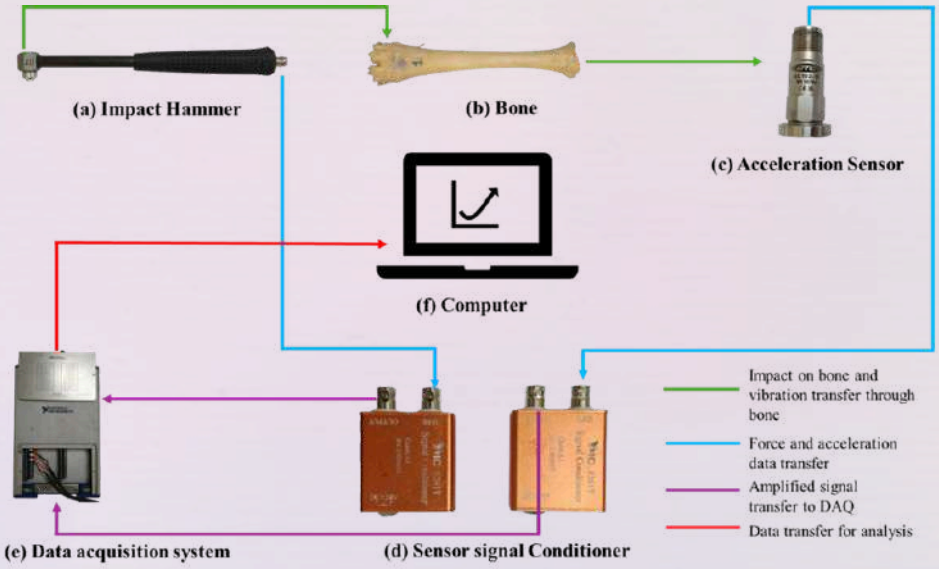

Figure 2. (a) Impact hammer (b) bone specimen, (c) accelerometer (d) sensor signal conditioner (e) data acquisition system (f) computer equipped with Sig view software

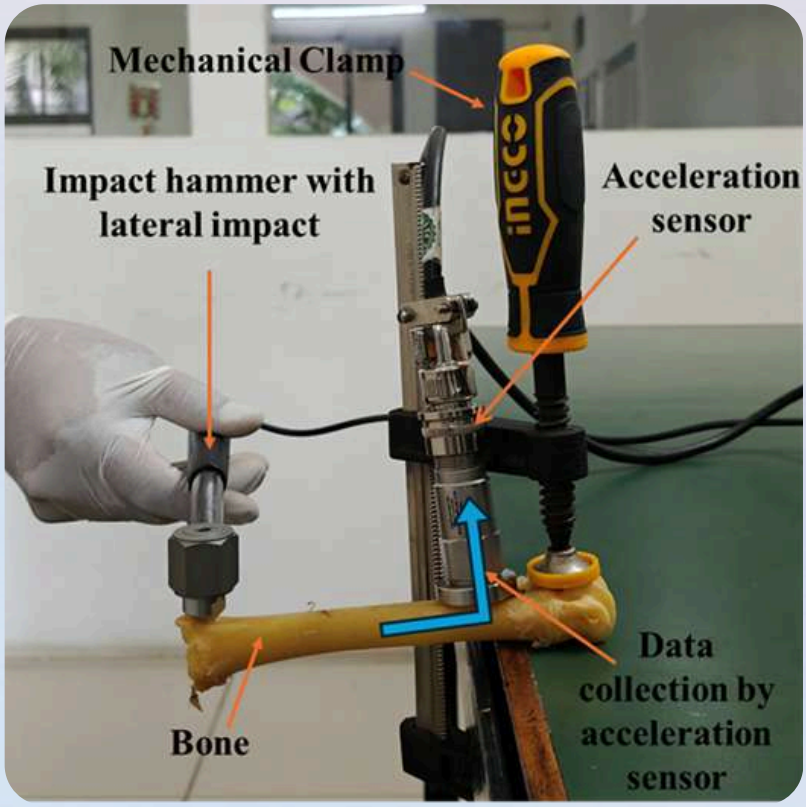

Figure 3. Experimental setup for lateral impact test on bone

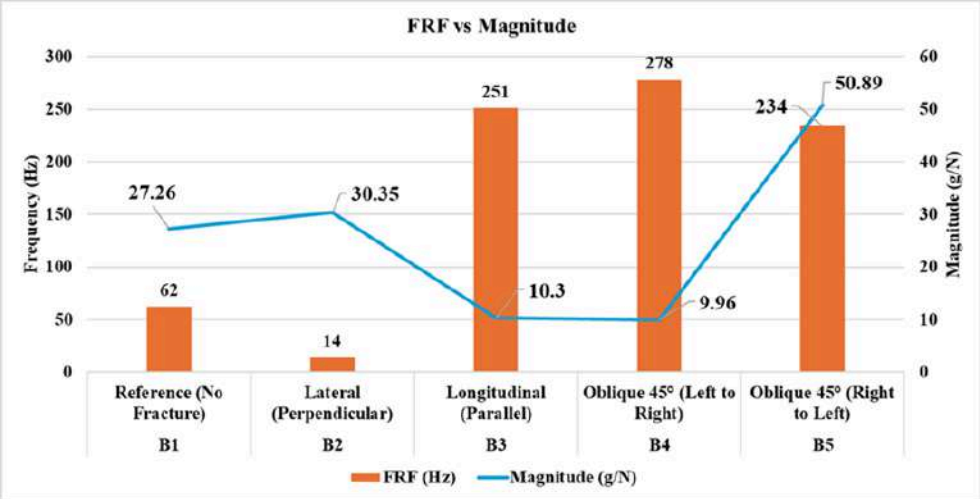

Figure 4. Frequency response function (FRF) resonance frequencies and peak magnitudes for bone specimens with various fracture orientations, illustrating changes in stiffness and damping due to fracture severity

This work establishes vibration analysis as a promising radiation-free, low-cost supplementary diagnostic tool for fracture severity assessment. With further validation on larger sample sizes and in vivo studies, this approach has strong potential for clinical screening, fracture healing monitoring, and deployment in remote or resource-limited healthcare settings, particularly benefiting radiation-sensitive populations such as pregnant women, children, and elderly patients.

Editor's Note

This short communication is based on the following Journal Publication of the Authors:

Title : Experimental investigation of fracture orientation effects on bone dynamics behavior through vibration analysis

Name of Journal : Advances in Science and Technology Research Journal (ASTRJ) (Scopus & ESCI)

Author : Jignesh Jani & Dr. Nikunj Rachchh

DOI : https://doi.org/10.12913/22998624/211667

Equipment Assessment with Predictive Maintenance Techniques

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Director / Sr. Consultant, Asset Management Consultant

1. Introduction

The objective of employing Predictive Maintenance techniques is to monitor deviation from normal equipment condition and ascertain faults at the incipient stage of development so that corrective actions may be taken in time to avoid failures. The term Predictive Maintenance is also known as 'Condition Monitoring' or 'Condition Based Maintenance'.

2. Predictive techniques are used for the following purposes

- Detect deviations from normal performance of a machine & incipient faults &take corrective actions
- Optimize the functioning of equipment &prolong overhaul schedules, Helps in Maintenance Planning
- Accept a machine during commissioning stage &assess a machine for its ability to operate at high performance

3. Methods of Monitoring Equipment Condition

Since monitoring of deviations from 'normal' equipment conditions requires finer perceptions than the human senses can provide, special instruments and techniques are employed for this purpose. Condition Monitoring techniques fall into one of six categories, according to the symptoms or potential failure effects it monitors:

- Dynamic Effects
- Temperature Effects
- Particle Effects
- Physical Effects
- Electrical Effects
- Chemical Effects

4. Understanding 03 Key Effects for Equipment Assessment (Dynamic, Temperature & Particle Effects)

(A) Dynamic Effects

The methods within this classification detect failures, particularly of rotating equipment, that result in abnormal energy emission in form of waves – for example, vibration, pulses or noise. There are many techniques but these are broadly classed under Vibration Monitoring and Analysis.

Vibration Monitoring and Analysis:

- **Broad Band Vibration Analysis.** This technique monitors changes in vibration characteristics caused by problems such as wear, fatigue, mechanical looseness or misalignment.
- **Shock Pulse Monitoring**. This technique is also referred to as High Frequency Domain (HFD) monitoring and Spike Energy monitoring. This technique monitors surface deterioration and lack of lubrication in devices such as pneumatic impact tools, internal combustion and bearings.
- **Frequency Analysis (Real Time).** This approach monitors shock, transient, acoustic &vibrational signals. It provides instantaneous updated graphical displays of analyzed frequency domain spectra.
- **Envelope Technique.** This technique detect bearing condition of slow and very slow moving bearings.
- **Ultrasonic leak detection.** This detects leaks & other sources of very high frequency noise in heat exchangers, underground tanks and steam condensers.

(B) Particle Effects

The technique to monitor particle effects is Ferrography. Also known as Wear Debris Analysis.

- **Ferrography / Wear Debris Analysis**

  This technique is used for monitoring fatigue, wear and corrosion in enclosed lubricating and hydraulic oil/grease systems. It measures particle shapes, sizes, edge formation and morphology to detect incipient wear/damage, even at times, much before vibration monitoring shows damage.

(C) Temperature Effects

Various techniques that measure temperature effects. The most powerful is Infrared Thermography.

- **Infrared Thermography**

  This method, which is applied to items including transformers, hydraulics, MCC, PCC, switchyards, chimney stacks, refractory lining condition, heat loss measurement, building insulations and electrical switchgears, identifies changes in heat transfer characteristics due to delamination of laminated materials or to variation in temperature caused by fatigue, leaks, wear or other problems.

Contributed by Dr Arun Jalan, FCVS

Let's Crack this Brain Teaser!

Unscramble these six jumbles, one letter to each square, to form six technical words.

1. G E T H S N R T

2. M E L T E R B

3. B A Y S T I L T I

4. S I N G M A I L

5. T E C H A R T

6. M E A T U P L I D

Now, arrange the circled letters to form the surprising answer. Take the hint from the above image.

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West (Mumbai)	59	32	4	95
Overseas	9	2	1	12
Total	176	82	9	267

Category of Membership	Mumbai & West	Bengaluru & South	Kolkata & East	Delhi & North	Overseas
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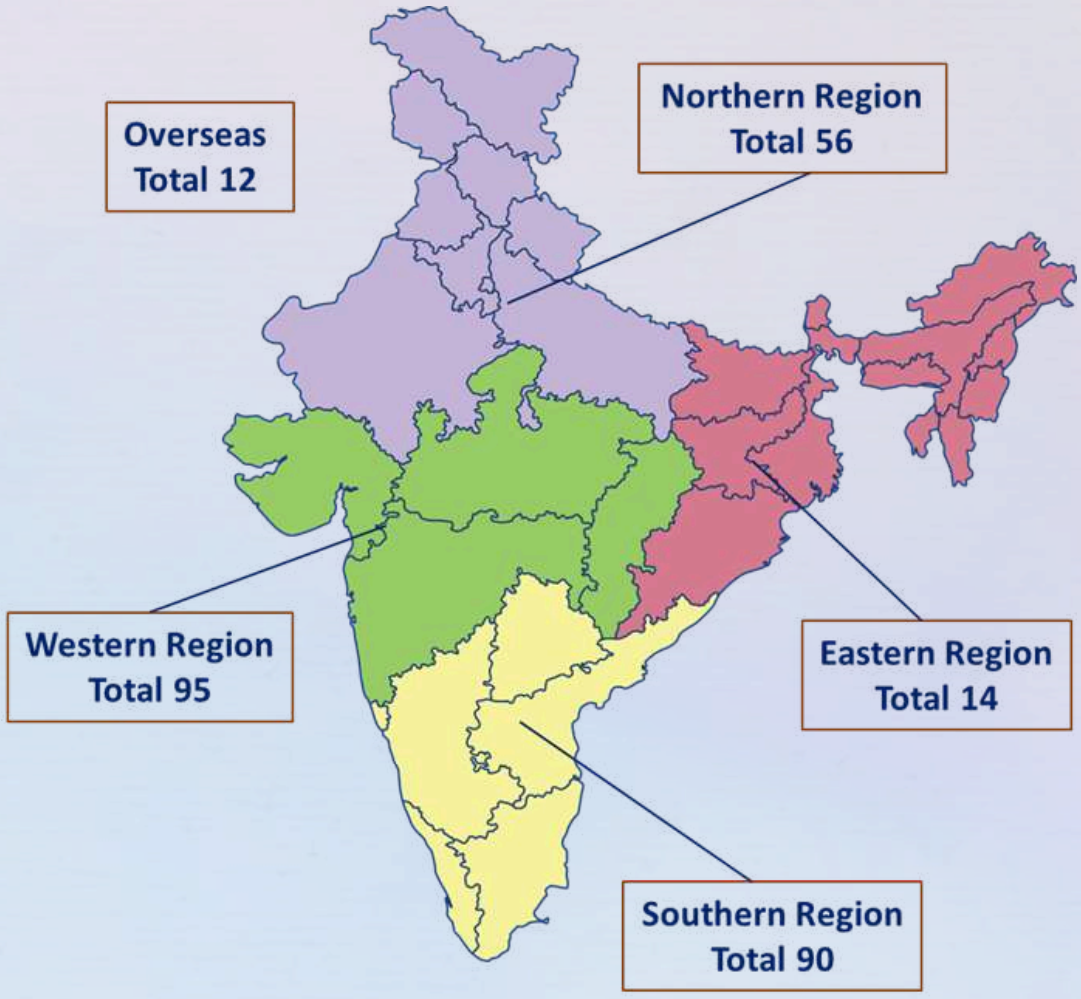
Total	96	89	14	57	11

(As on 31 December 2025)



Solution to the CVS Word Puzzle

1. GETHSNRT

S	T	R	E	N	G	T	H

2. MELTERB

T	R	E	M	B	L	E

3. BAYSTILTI

S	T	A	B	I	L	I	T	Y

4. SINGMAIL

M	I	S	A	L	I	G	N

5. TECHART

C	H	A	T	T	E	R

6. MEATUPLID

A	M	P	L	I	T	U	D	E

FINAL ANSWER

S	E	I	S	M	I	C

M	E	A	S	U	R	E	M	E	N	T

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HYBRID MODULAR ENGINEERING

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Hybrid Modular Engineering, introduced by VIBES.technology, is a product development strategy that combines test & simulation at the component level to develop, update, and optimize complex products. VIBES develops user-friendly solutions, provides engineer training and works as a consultant for customers around the world.

At VIBES, solutions are built to address specific engineering challenges in sound and vibration. Each solution is designed to support engineers in obtaining reliable, high-quality data early in development. By aligning with real engineering processes, our solutions help teams work more efficiently and solve the right problems with confidence.

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

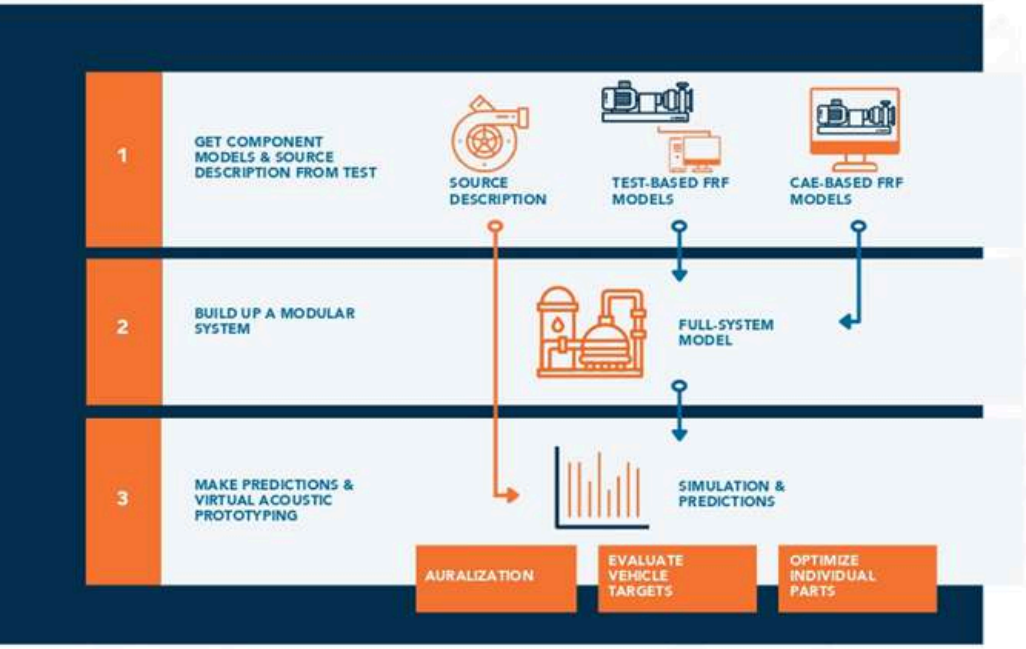
Standardized source descriptions, such as blocked forces, make it possible to characterize active vibration sources independently of the receiving structure. These models can be reused across platforms and integrated into simulations or benchmarking activities.

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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Our experts on demand offer customized solutions for every vibration issue. A team of technical consultants helps you optimize complex engineering processes and shows the power of VIBES' methodology on any challenge.

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HAPPY NEW YEAR

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