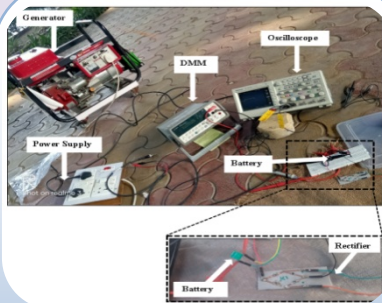
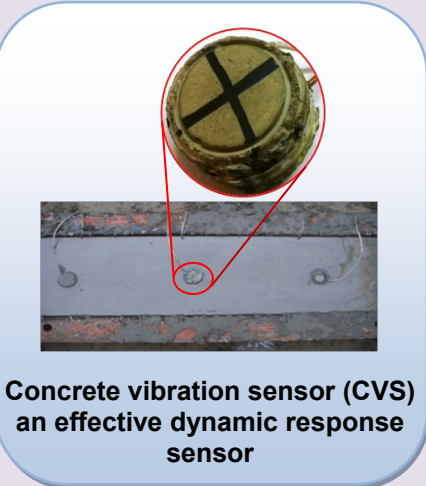
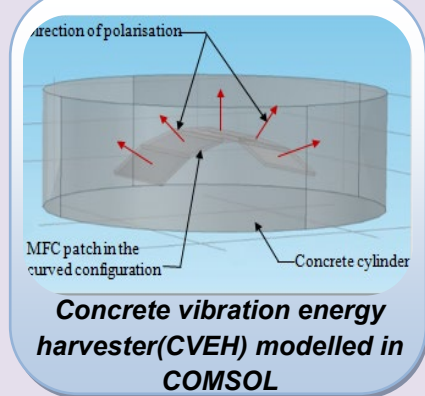
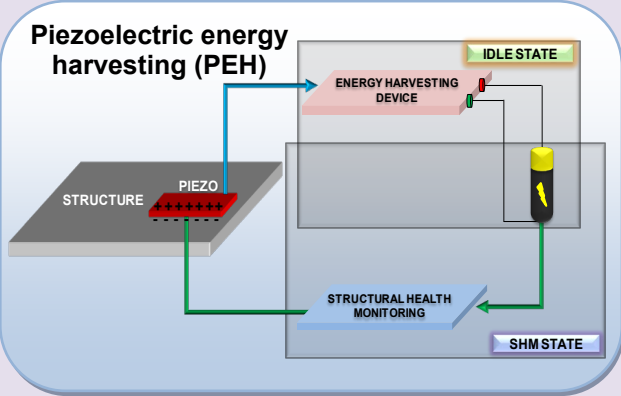


The **Smart Structures and Dynamics Laboratory (SSDL)** was founded in 2007 to establish dynamic measurement facilities and research based on smart materials and to develop new technologies to monitor the health of civil structures. SSDL is furnished with modern equipment such as dynamic signal acquisition systems, LCR meters, oscilloscopes, function generators, portable dynamic shakers and amplifier, accelerometers and many other cutting edge facilities. It uses accelerometers and piezoelectric ceramic (PZT) patches as dynamic response sensors, both in low and high frequency modes. In addition, SSDL has an operational **Virtual Smart Structures and Dynamics Laboratory (VSSDL)** component with specialised capability to facilitate remote triggered/ simulation based online experiments for engineering students at undergraduate and post graduate levels.



Field experiment: piezoelectric energy harvesting (PEH) from traffic-induced vibration



Concrete vibration sensor (CVS) an effective dynamic response sensor

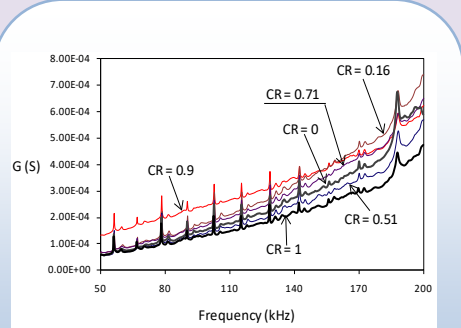


Concrete vibration energy harvester (CVEH)

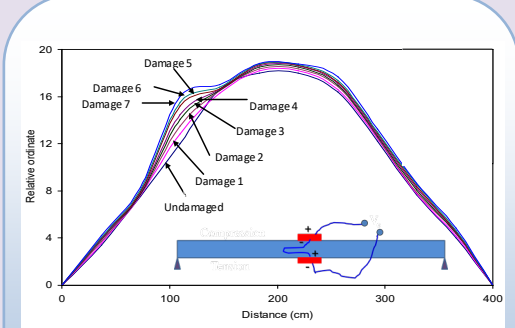
RESEARCH AREAS



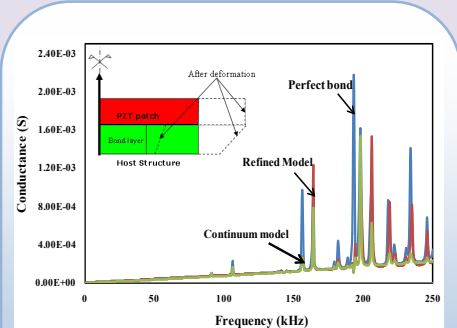
Multipurpose energy dissipation devices



Electro-mechanical impedance (EMI) technique



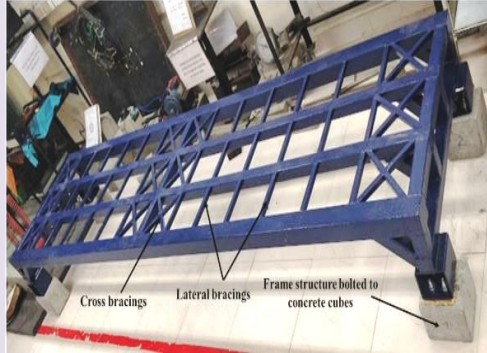
Damage localization in structural health monitoring (SHM)



Piezo-structure bond elastodynamic modelling



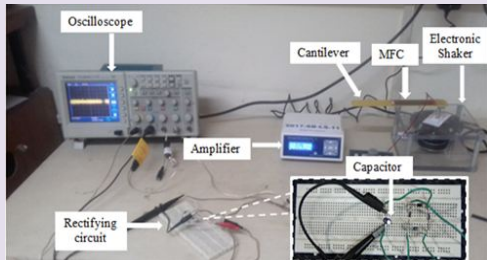
Experimentation for course structural health monitoring (CVL 864)



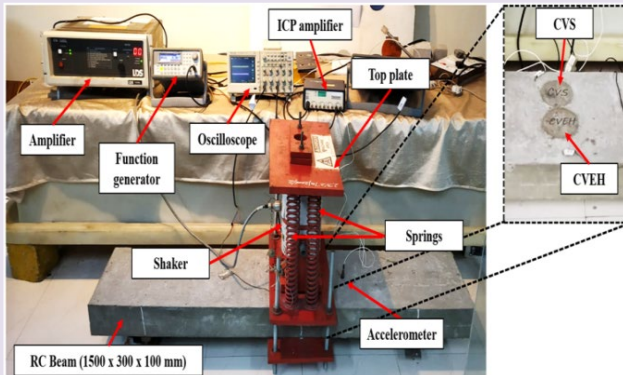
Scaled-down model of deck of slab of Panchsheel pedestrian foot over bridge



Experimental measurement by IITD & Dholera Industrial City Development Limited (DICDL) team near canal bridge



Piezoelectric energy harvesting (PEH)



Experimental study for energy harvesting with shaker to simulate field conditions.

PROJECTS

SPONSORED R & D PROJECTS

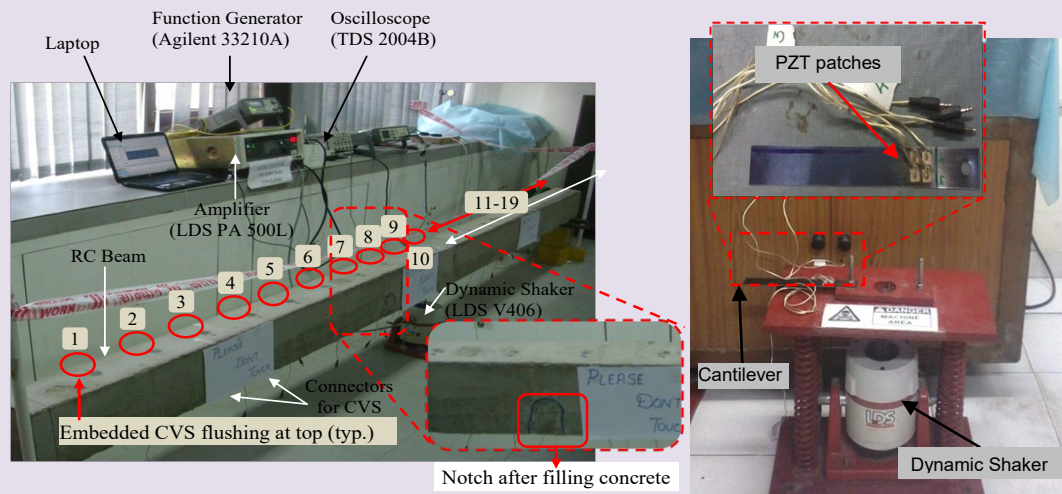
S. No	TITLE	INVESTIGATORS	FUNDING AGENCY
1	Virtual Labs Project (Phase III extended)	Prof. Suresh Bhalla Prof. Ranjan Bose	Ministry of Education (MoE)
2	Bayesian Model Updating Approach for Systematic Damage Detection	Prof. Sahil Bansal Prof. Suresh Bhalla	Aeronautics R & D Board, (Directorate of Aeronautics India)
3	Structural Health Monitoring of RC/ Steel Structures through Wireless Mode.	Prof. Suresh Bhalla	Livehoah Technologies Pvt Ltd
4	Investigation of Alstrong wall Panels With Zinnia Technology Under Wind Loads	Prof. Suresh Bhalla	Alstrong Enterprises (India) Pvt. Ltd
5	Development of Low-cost Remote Health Monitoring System for Civil/ Mechanical/ Aerospace Structures Using Piezo-Ceramic Sensors	Prof. Suresh Bhalla Prof. Ashok Gupta	Armament R&D Establishment (DRDO)

MAJOR TYPE-A CONSULTANCY PROJECTS

S. No	TITLE	INVESTIGATORS	FUNDING AGENCY
1	Strategies For Piezoelectric Energy Harvesting from Vehicular Movements on Roads and its Utilization for Powering Traffic Signals	Prof. Suresh Bhalla	Dholera Industrial City Development Limited
2	Assessment of Vibrations Induced in TCIL Bhawan, Greater Kailash-I, New Delhi	Prof. Suresh Bhalla	Telecommunications Consultants India Limited (TCIL)
3	Investigation of Excessive Vibrations at King's Canyon (B2) Building ASF Insignia SEZ Gurgaon : Part (I): Measurement. Part (II): Remedial Measures	Prof. Suresh Bhalla	ASF Insignia SEZ Private Limited
4	Investigation and Remedial Measures for Excessive Vibrations in PNB Building at Parliament Street	Prof. Suresh Bhalla Prof. Alok Madan	Punjab National Bank

RECENT INTERNATIONAL CONFERENCE

DATE	TITLE	INSTITUTE
22-Jan 2021 to 24-Jan-2021	INTERNATIONAL CONFERENCE ON FUTURISTIC TECHNOLOGIES 2021	IIT DELHI



Experimental studies related to piezo-electric energy harvesting (PEH)



International Conference on Futuristic Technologies 22-24 January 2021 (FT21)



RECENT PUBLICATIONS

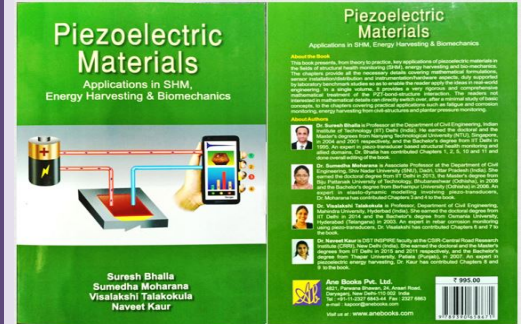
1. Dattar, S. A., and Bhalla, S. (2022) , "Performance Evaluation of Piezo sensors with respect to accelerometers for 3D modal analysis of structures", *Smart Materials & Structures*, Vol.31 (Aug) 095043 No. 9, DOI:10.1088/1361-665X/ac858a
2. Addala, M. B., Bhalla, S. and Madan, A. (2022), "Controlling Dynamic Response of Structures Using Hybrid Passive Energy Dissipation Device" *Journal of Earthquake Engineering*, Vol. 26, No 6 (June) on 03 Aug 20. DOI: 10.1080/13632469.2020.1792378
3. Haq, M., Bhalla, S. and Naqvi, T. (2022), Piezo-Impedance Based Fatigue Damage Monitoring of Restrengthened Concrete Frames", *Composite Structures*, Vol. 280, No 1 (Jan), paper no 114868. DOI: 10.1016/j.compstruct.2021.114868
4. Aulakh, D. S., and Bhalla, S. (2021), "3D Torsional Experimental Strain Modal Analysis for Structural Health Monitoring Using Piezoelectric Sensors", *Measurement*, Vol 180 (Aug), paper no. 109476, DOI: 10.1016/j.measurement.2021.109476
5. Raju, J., Bhalla, S. and Talakokula, V. (2020), "Pipeline corrosion assessment using piezo-sensors in reusable non-bonded configuration", *NDT&E International*, Vol 111 (Apr), 102220, pp. 1-16. DOI: 10.1016/j.ndteint.2020.102220
6. Balgavhar, S. and Bhalla, S. (2019), "Evaluation of Power Extraction Circuits on Piezo Transducers Operating under Low-Frequency Vibration Induced Strains in Bridges", *Strain*, Vol. 55, No. 3, (June), e12303. DOI: 10.1111/str.12303
7. Bhalla, S. and Kaur, N. (2018), "Prognosis of Low-Strain Fatigue Induced Damage in Reinforced Concrete Structures Using Embedded Piezo-Transducers", *International Journal of Fatigue*, Vol. 113 (Aug), pp. 98-112. DOI: 10.1016/j.ijfatigue.2018.04.00
8. Srivastava, S., Bhalla, S. and Madan, A. (2017), "Assessment of Human Bones Encompassing Physiological Decay and Damage Using Piezo Sensors in Non-Bonded Configuration", *Journal of Intelligent Material Systems and Structures*, Vo. 28, No. 14 (Aug), pp. 1977-1992. DOI: 10.1177/1045389X16672

RECENT WORKSHOPS

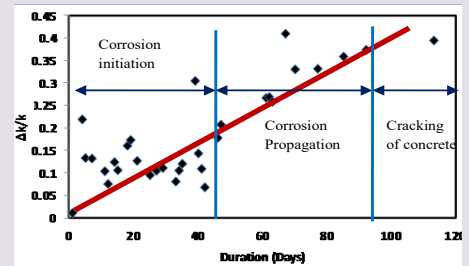
- 19 Sep 2020 E-WORKSHOP ON BIOMEDICAL TECHNO INNOVATIONS AND HEALTH MONITORING
- 05 Sep 2020 E-Workshop ON STRUCTURAL HEALTH MONITORING USING IOT & MACHINE LEARNING.
- 22 Aug 2020 E-WORKSHOP ON FUTURISTIC ENERGY HARVESTING USING SMART AND META MATERIALS
- 27 June 2020 E - WORKSHOP ONEARTHQUAKE: EFFECTS ON STRUCTURES AND FUTURISTIC MITIGATION TECHNIQUE
- 16 May 2020 E-WORKSHOP ON FUTURISTIC SENSING TECHNOLOGIES FOR CIVIL MECHANICAL & INSTRUMENTATION ENGINEERS



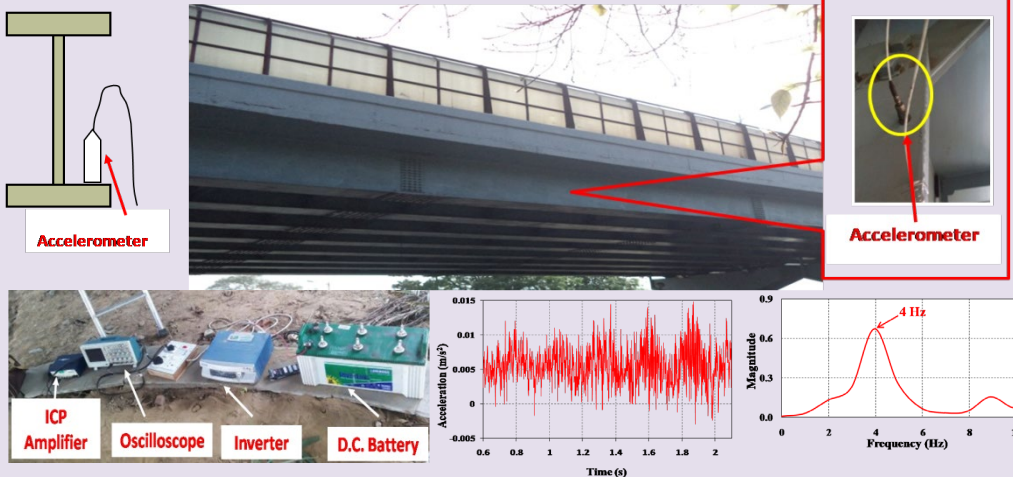
Bio-medical applications of piezo-sensors



Piezoelectric Materials, Applications in SHM, Energy Harvesting and Biomechanics (Indian Edition)



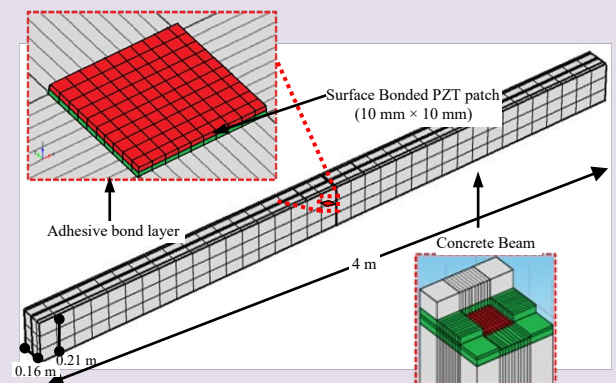
Predictive models for carbonation and chloride induced corrosion



Experimental setup for energy harvesting from real life bridge vibrations at Jia Sarai flyover, near IIT Delhi



Virtual Smart Structures and Dynamics Lab (VSSDL)
Please visit <http://ssdl.iitd.ac.in/vssdl/home.html> or <https://web.iitd.ac.in/~sbhalla/index.html>



Simulation studies in COMSOL for piezoelectric energy harvesting based on surface-bonded and embedded PZT sensors

PEOPLE

FACULTY MEMBERS ASSOCIATED WITH LAB

- Prof. Suresh Bhalla, Professor, Civil Engineering Department (Lab Founder and Mentor)
- Prof. Alok Madan, Professor, Civil Engineering Department
- Prof. Sahil Bansal, Department of Civil Engineering

DOCTORAL/M-TECH PROJECTS

S.NO	NAME	TITLE	GUIDE
DOCTORAL PROJECTS COMPLETED (11 Nos.)			
1	Dr. Mahesh Babu Addala	Structural control of building frames using hybrid control devices based on energy	Prof. Alok Madan and Prof. S. Bhalla
2.	Dr. Mohd Moin ul Haq	Fatigue damage detection of structures using PZT sensors. (Student registered at AMU Aligarh)	Dr. S. Bhalla & Prof. Tabassum Naqvi
3.	Dr. Sumit Balguvhar	Piezoelectric energy harvesting through low-frequency non-sinusoidal vibrations of civil structures	Prof. S. Bhalla
4.	Dr. S.K. Dhawan	Expected residual service life of reinforced concrete structures	Prof. S. Bhalla, Prof. B. Bhattacharjee
5.	Dr. Shashank Srivastava	Bio-medical diagnosis of bones through collocated action of shape memory alloy (SMA) actuators and piezo sensors	Prof. S. Bhalla, Prof. A. Madan and Prof. A. Gupta
6.	Dr. Diwakar Bhagat	Engineered bamboo structures: Development of high capacity fibre reinforced bamboo composite structural members	Prof. S. Bhalla, Prof. Roger west
7.	Dr. Naveet Kaur	Integrated structural health monitoring and energy harvesting potential of thin piezo patches operating in d31 mode	Prof. S. Bhalla
8.	Dr. Visalakshi Talakokula	Corrosion assessment in rebars of RC structures using equivalent parameters extracted from piezo-patches	Prof. S. Bhalla and Prof. A. Gupta
9.	Dr. Sumedha Moharana	Modelling of piezo-structure elastodynamic interaction through bond layer for electro-mechanical impedance technique	Prof. S. Bhalla
10.	Dr. Ramashankar	An Integrated approach for structural health monitoring	Prof. S. Bhalla and Prof. A. Gupta
11.	Dr. Ramakant Panigrahi	Development, analysis and monitoring of dismantlable tensegrity structures	Prof. A. Gupta and Prof. S. Bhalla
DOCTORAL PROJECTS IN PROGRESS (6 Nos.)			
1.	Rajpurohit Kiran	Bayesian model updating for systematic Damage Detection	Prof. S. Bansal and Prof. S. Bhalla
2.	Ms. Shipra Prakash	Integration of carbon-nano tubes and piezo sensors for achieving self-sensing concrete for static and dynamic response measurement	Prof. S. Bhalla
3.	Mr. Dattar Singh	Piezosensors based 3D modal analysis for structural health monitoring	Prof. S. Bhalla
4.	Mr. Raushan Kumar Ravi	Artificial intelligence enabled structural health monitoring using smart materials	Prof. S. Bhalla and Prof. A.K. Jain
5.	Ms. Jayalakshmi Raju	Corrosion assessment in pipelines using piezoelectric transducers	Prof. Suresh Bhalla and Prof. T. Visalakshi
6.	Mr. Jashanjeet Randhawa	Structural health assessment in the absence of baseline data	Prof. S. Bhalla
M-TECH PROJECTS IN PROGRESS (6 Nos.) (2022-23) [TOTAL MTECH PROJECTS COMPLETED: 56 Nos.]			
1.	Maj. Anuj Singh	Experimental evaluation of hybrid FRBC members	Prof. S. Bhalla
2.	Ms. Divya Rawat	Reusable sensors for structural health monitoring	Prof. S. Bhalla
3.	Ms. Madhu Yadav	Experimental and numerical investigation on efficiency of spherical doubly curved thin piezo transducers for energy harvesting and structural health monitoring	Prof. S. Bhalla
4.	Ms. Pulkit Pawan	Finite element modelling of hybrid of fiber reinforced bamboo composite members	Prof. S. Bhalla
5.	Mr. Mahabalashwara J	Durability test of bamboo in bamboo reinforced beams	Prof. S. Bhalla
6.	Mr. Pratik Kamble	Structural health monitoring using carbon nanotubes based concrete	Prof. S. Bhalla

SSD LAB TEAM (2022-23)



Please visit <http://ssdl.iitd.ac.in/vssdl/home.html> or <https://web.iitd.ac.in/~sbhalla/index.html> for more details

Prof. Suresh Bhalla (Lab Founder and Mentor)

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Civil Engineering Department, Block-V, Room No. - 211
Indian Institute of Technology Delhi, India-110016

Phone: (+91)11-2659-1040, Email: sbhalla@civil.iitd.ac.in, Web: <http://ssdl.iitd.ac.in>



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