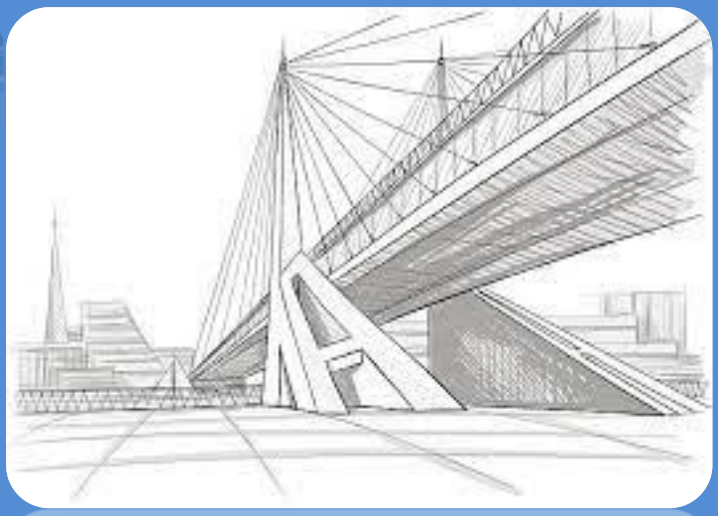
KDM Engineers (India)Pvt Ltd

Complete Civil Engineering solutions

STRUCTURAL HEALTH MONITORING, ASSESSMENT & REHABILITATION



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Our services:

- Structural Health Monitoring
- Long term (live monitoring) monitoring of structures.
- Modal Analysis
- Condition Assessment and Condition mapping.
- Consultancy Services for suggesting remedial measures, structural strengthening, and rehabilitation.
- Non-Destructive/Semi Destructive testing to check the integrity of structures.
- Rail Structure Interaction studies and Instrumentation works on Railway Bridges.

Structural Health Monitoring, Assessment &Rehabilitation

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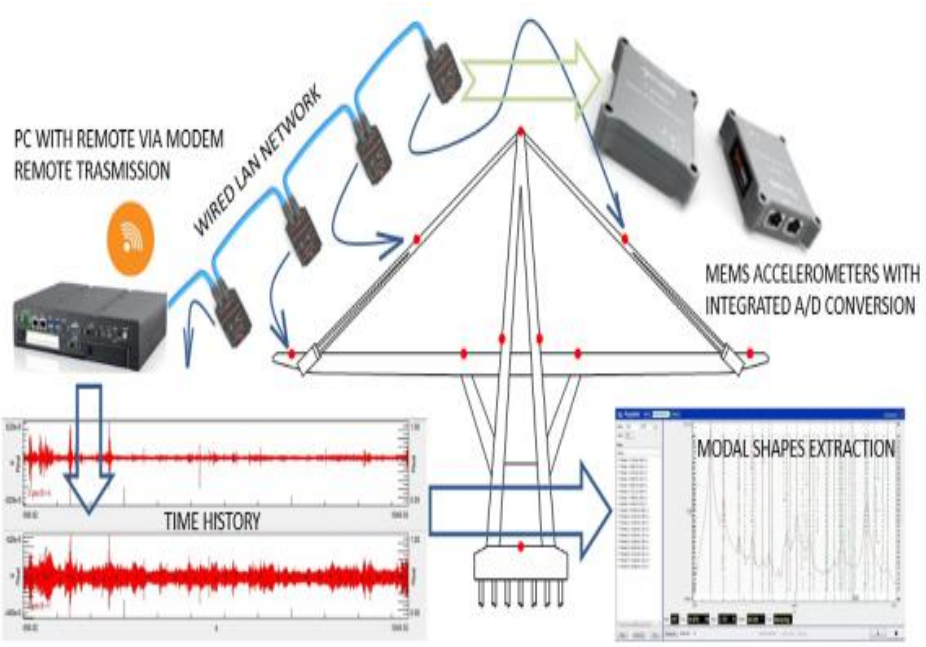
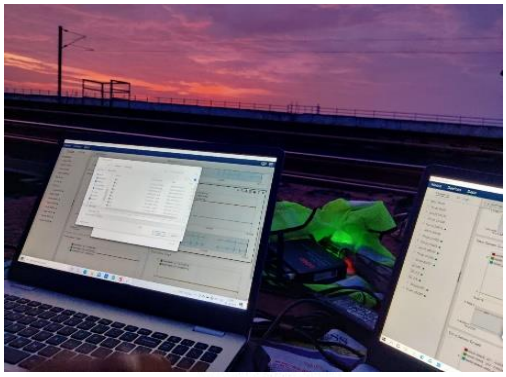
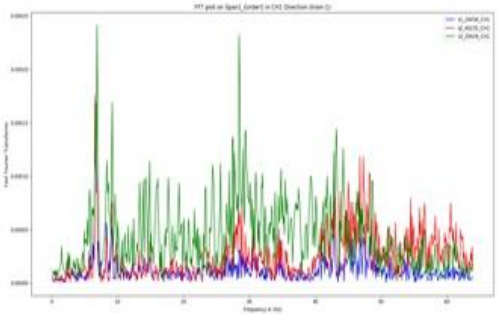
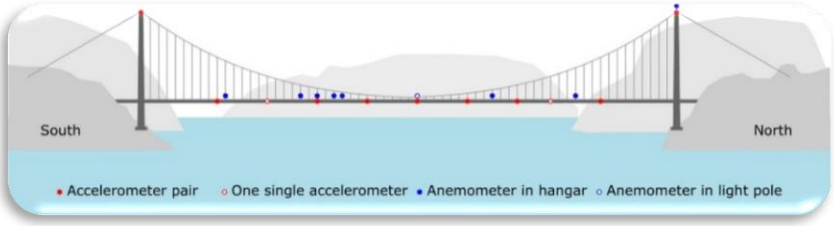
Complete Civil Engineering Solutions









About Us

We provide solutions for health monitoring & assessment of civil structures for understanding the global behavior by instrumentation at strategic locations. Finding parameters such as acceleration, modal frequencies, displacements, stresses, strains and forces induced under dynamic loading.

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Research Collaboration

Structural Health Monitoring, Assessment and Rehabilitation

Mahindra University
Global Thinkers. Engaged Leaders.

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Structural Health Monitoring, Assessment & Rehabilitation (SHMA& R)

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What is SHM

The Process of systematizing a damage detection and characterization techniques. It is a non-destructive in-situ structural evaluation method that involves several types of sensors embedded or attached to the structures for the purpose of assessing the actual conditions of the structures. Global and local structural behavior are considered on the basis of real-time data aggregation.

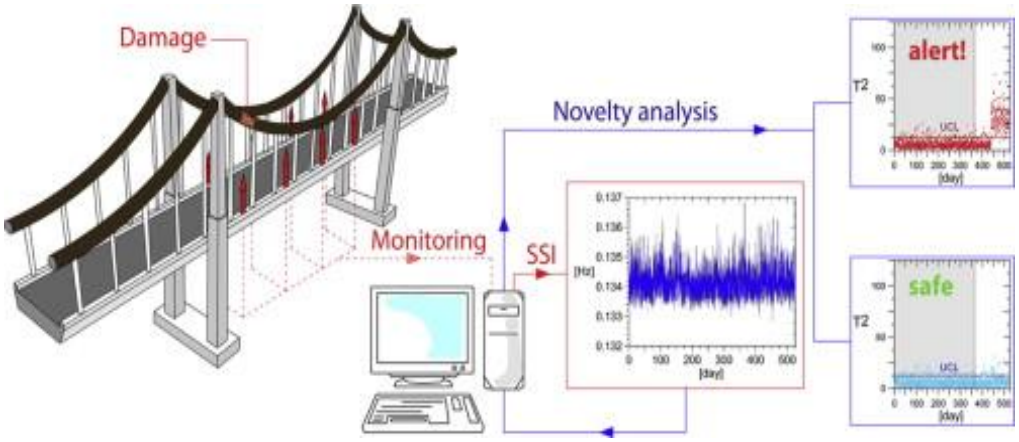
Why SHM

SHM provides a tool to ensure structural integrity and safety, detecting the growth of damages, and evaluating the performance of infrastructures.

Applications

SHM work for critical structures like

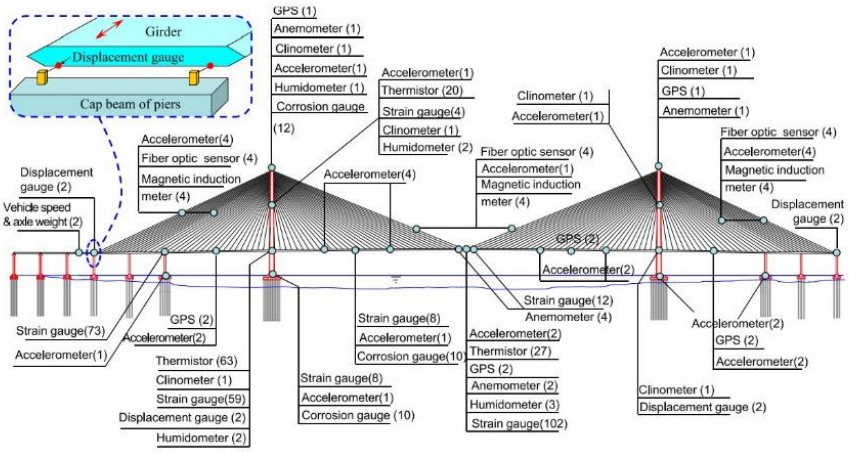
- Bridges
- Wind turbines
- Tunnels
- Rail structures
- Power plants and dams.
- Historic buildings
- Substructures
- Water resources
- All types of structural applications

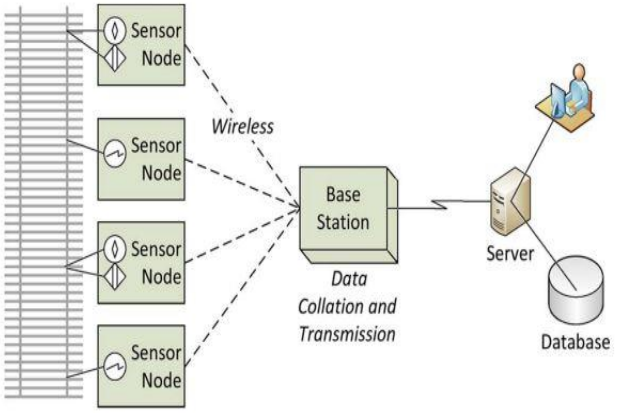


SHM Involves:

- Performance enhancement of an existing structure
- Identifying structures affected by any external factors
- Continuous Health monitoring
- Reduction of uncertainty
- Discovering hidden structural reserves
- Examining deficiencies
- Structure's long term quality promotion
- Asset and Engineering knowledge elevation
- Asset lifespan extension
- Post-earthquake structural integrity
- Operational Evaluation
- Improve performance (safety and functionality) of existing structures.
- Help to design better structures in the future
- Observers to assess the structure's condition and its remaining life span.
- Data Feature extraction
- Statistical models development
- Cost reduction, cost-effective maintenance.

Processing Phases





Stages of SHM

Installation Preprocessing

- Initial site visit and investigate to find and install the exact locations of the sensors
- Make the surface as suitable for installation
- Some sensors we can fix directly on the structural elements. Or else using 'L' clamp for sensor installation

Power supply

- Most of the instruments are working with DC power. We are preferring Solar, battery power, generator and direct power supplies

Sensors

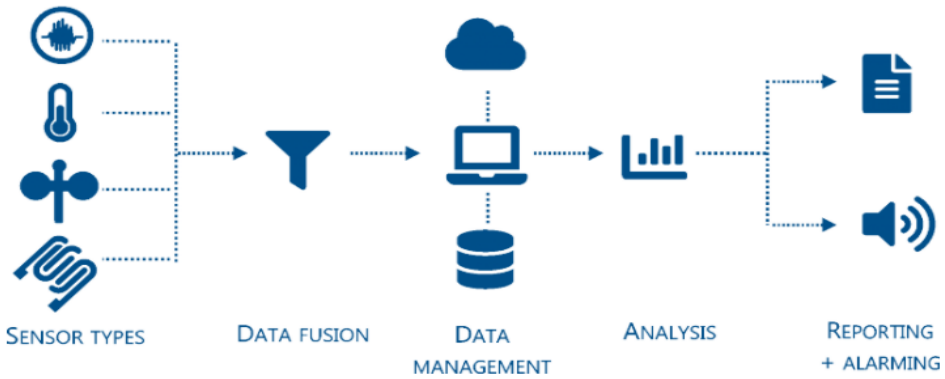
- We are using various sensors for various applications
- Like Accelerometer, tilt meter, strain gauge, displacement sensor, temperature sensor, load cell etc.
- These sensors measure physical properties of the medium and convert analog / digital format

Data aggregator

- Data acquisition from wireless and inertial sensors. Aggregator collecting sensor data.
- From this aggregator we can directly collect sensor data through Ethernet & SensorCloud, MicroUSB.
- Data is securely stored, viewed and analytic operations/alert set up.

Software's

- Sensor Connect is specially designed software for plotting the aggregator received data
- MATLAB for relative displacement and velocity. Most of the instrument manufacturer providing their own software's for analysis



Advanced SHM Instrumentation & Data Aggregation

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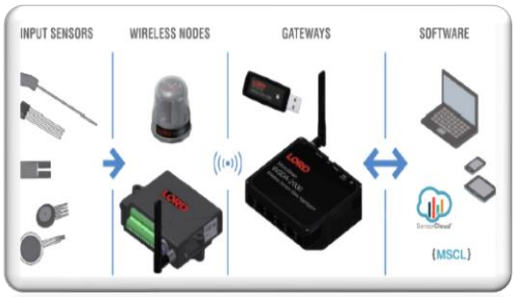
Accelerometer Sensor

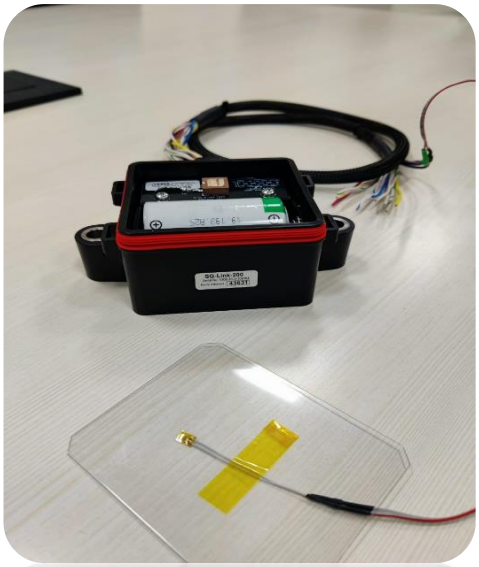
The triaxial accelerometer allows high-resolution data acquisition. It can record vibrations upto ±8g with extremely low noise and drift. Derived vibration parameters allow for logarithmic monitoring of key performance indicators. These wireless sensing systems are ideal for test and measurement, remote monitoring, system performance analysis, and embedded applications.



Strain Gauge Sensor

A Strain gauge is a sensor whose resistance varies with applied force; it converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured.

When external forces are applied to a stationary object, stress and strain are the result.



Displacement sensors

An LVDT consists of a metal rod that moves inside an electrical coil. A force applied to the rod results in a displacement that affects the inductance of the coil. It is a common type of electromechanical transducer that can convert the rectilinear motion of an object to which it is coupled mechanically into a corresponding electrical signal.

Load cell

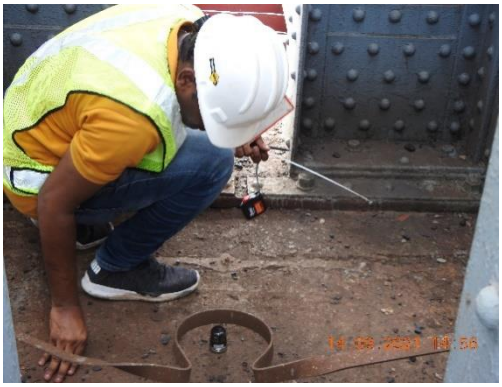
Most used load cell is the strain gage load cell. Several strain gages mounted in a Wheatstone bridge configuration so that the application of a force causes a strain in the assembly the strain gages are measuring. these devices are calibrated so that the force is directly related to the resistance change. pneumatic and hydraulic load cells translate force into pressure measurements. When force is applied to one side of the piston or diaphragm, the amount of pressure (pneumatic or hydraulic) applied to the other side to balance that force is measured.

Types of Installation

Long Term – Real Time Health Assessment

- Long term – Real-Time Health monitoring
- One month to unlimited number of months continuous recording
- Offline, Online, Cloud data aggregations

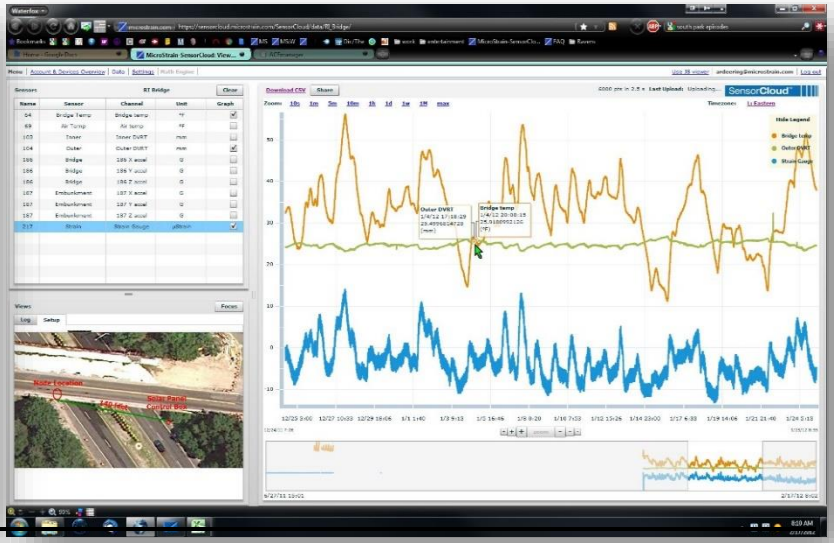
Short Term – Real Time Health Assessment



- Short term – Real-Time Health monitoring
- Summer, Winter, as client request
- Offline, Online, Onsite, Cloud data aggregations

Permanent installation while construction

- Permanently installed while construction.
- It's life long monitroing methodology
- Low-cost instruments
- Internal monitoring method



Completed Projects

Rail Structure Interaction (RSI) Validation for Bridge No. 175 - Navadgi (South Central Railway - India)

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Overview of the structure

This bridge is constructed on the river with pre-stressed concrete 'I' Girder supported on circular pier. The overall length of bridge is 81.00 m comprising 4 spans of each 20.00 m.

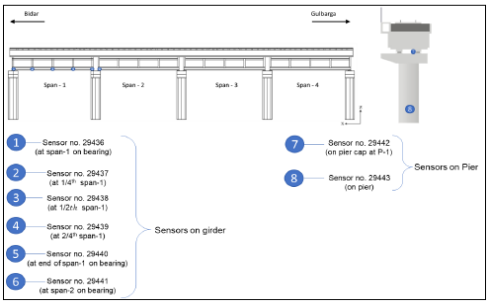
Objective

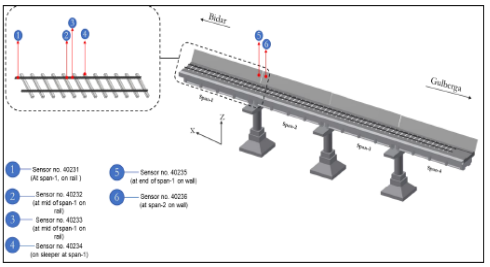
Rail structure interaction study is carried out to workout forces induced on rails, bridge components due to interaction effects and assess the safety due to these interaction forces on CWR. The interaction takes place due to expansion or contraction of deck and rails under change of temperature, longitudinal deformation of sub structure under braking, tractive forces from rolling stock and vertical bending/flexure of deck under live loads. SWR allows movements freely under thermal and live load effects whereas the rails as part of CWR doesn't allow free moments and hence a separate analysis is required for study of interaction forces is required.

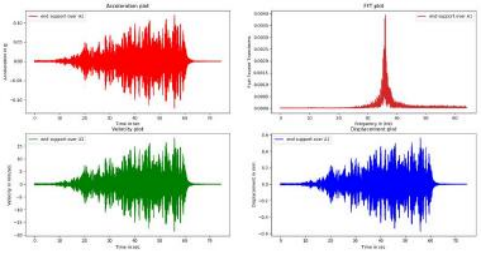
Scope of work

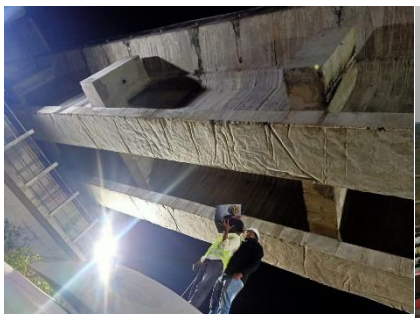
scope of work includes finding out the following parameters.

Maximum horizontal displacement of deck due to longitudinal loads. Relative displacement between rail and deck due to longitudinal loads. Additional tensile and compressive stresses in rails due to thermal loads in summer. Finding out the Maximum displacement in deck due to rotation. Maximum vertical displacement of deck at ends. Numerical Modelling and analysis. Generation of Finite element model using MIDAS









Live Projects

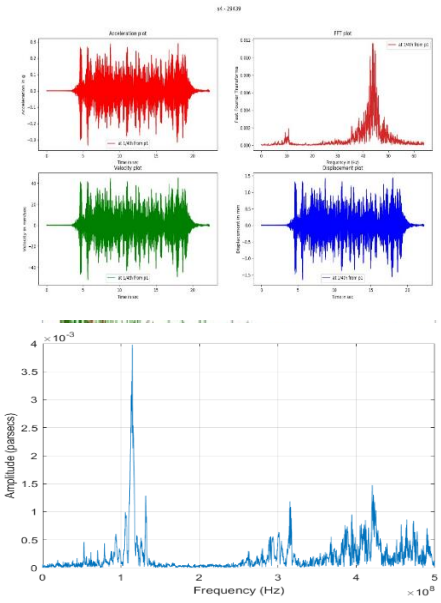
Rail Structure Interaction (RSI) Validation for Bridge No. 832 - Jagdalpur (East Coast Railway - India)

Overview of the structure

This bridge is constructed on the canal with composite Girder. The overall length of bridge is 61.00 m comprising 3 spans.

Objective

Bridge and track are interlinked, regardless of whether the system used for the track is the ballasted bed or it is directly fastened. Any force or deformation imposed on the track above or close to bridge structure will result in a force and deformation on the bridge structure or vice versa. So the rail structure interaction study is carried out to workout forces induced on rails, bridge components due to interaction effects and assess the safety due to these interaction forces.



Scope of work

scope of work includes finding out the following parameters like the interaction takes place due to expansion or contraction of deck and rails under change of temperature, longitudinal deformation of sub structure under braking, tractive forces from rolling stock (locomotive, wagons, other railway vehicles) and vertical bending/flexure of deck under live loads.

Live Projects

Rail Structure Interaction (RSI) Validation for Bridge No. 176 between Khariar-Nawapara stations (East Coast Railway - India)

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Overview of the structure

This bridge is constructed on the river with Pre-stressed concrete 'I' Girder supported on circular pier. The overall length of bridge is 36.60 m comprising 3 spans of each 12.20 m.

Objective

Rail structure interaction study is carried out to workout forces induced on rails, bridge components due to interaction effects and assess the safety due to these interaction forces on CWR. The interaction takes place due to expansion or contraction of deck and rails under change of temperature, longitudinal deformation of sub structure under braking, tractive forces from rolling stock and vertical bending/flexure of deck under live loads. SWR allows movements freely under thermal and live load effects whereas the rails as part of CWR

doesn't allow free moments and hence a separate analysis is required for study of interaction forces is required.

Scope of work

scope of work includes finding out the following parameters.

Maximum horizontal displacement of deck due to longitudinal loads. Relative displacement between rail and deck due to longitudinal loads. Additional tensile and compressive stresses in rails due to thermal loads in summer. Finding out the Maximum displacement in deck due to rotation. Maximum vertical displacement of deck at ends. Numerical Modelling and analysis. Generation of Finite element model using MIDAS

Live Projects

Structural Condition Assessment for Bridge No. 142 – Mancherial Stone Masonry (SC Railway - India)

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Overview of the structure

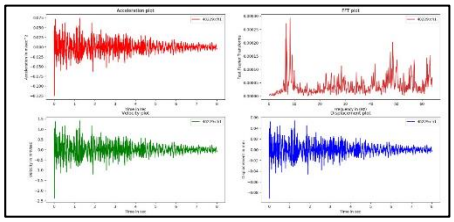
This bridge is constructed on the river Godavari in year 1929. Its is a plate girder supported on masonry piers connecting Mancherial and Ramagundam stations. The overall length of bridge 1.20 Km comprising 44 spans of 22.40 m.

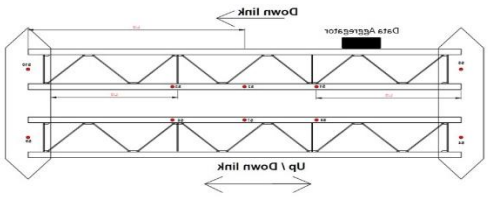
Objective of Project

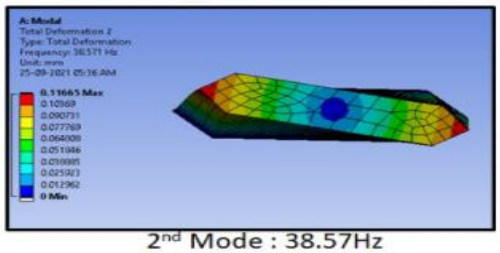
As the bridge is constructed long back, the structure of bridge is being deteriorated over the period. The condition of bridge must be monitored and assessed for the aim of keeping safety and facilitating maintenance.

Scope of work

Instrumentation for Structural condition assessment & validation of results by evaluation of natural frequencies, stiffness, parameters by Ambient Vibration Test (AVT), OMA and Numerical modal analysis.

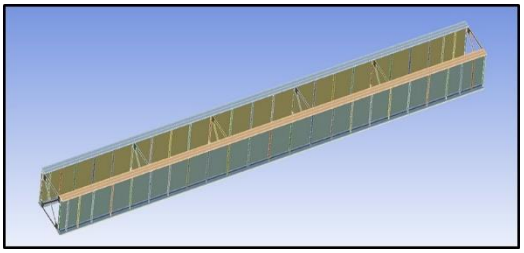






Outcome of project

The natural frequencies of piers and girders has been obtained from Numerical modal analysis ,AVT and compared to identify the critical piers . Bridge piers stiffness and damping properties under dynamic loads are derived. Identifying critical piers and recommendation will be suggested for strengthening if necessary.



Live Projects

Vibration Analysis for Bridge No. 375 – Gadwal Before and After Bearing Replacement (SC Railway - India)

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Overview of Structure

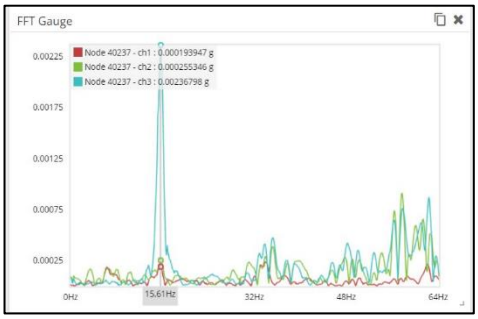
The bridge is constructed across Okku Setty river which is a tributary river of Krishna. The overall length of bridge is 254.40m with 21 spans of 12.20 m. The superstructure of bridge is PSC box girders supported on RCC piers and resting on open foundation.

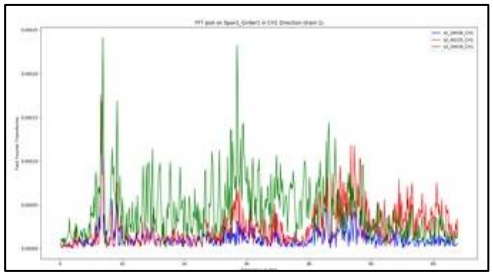
Objective of Project

The Structural Health Monitoring system is designed to compare and analyse the of vibrations and displacements on the bridge due to different live loads from train. The elastomeric bearings of the bridge has exceeded the service life of more than 20 years. The bearings at most of the locations has been worn out, bulged and damaged. Due to nonfunctioning of bearings higher stresses, vibrations were evident. The objective of te project is to compare the vibrations experienced on the structure before and after replacement of bearings.

Scope of the Work

Carrying out visual inspection, Ambient Vibration Test (AVT) to check condition of bridge and to identify the system properties for bridge deck. Accelerometer sensors are used to record the vibration data from current ongoing traffic/train before and after bearing replacement on the bridge.





Outcome of project

Comparison, analysis of vibrations, FFT plots and displacement of the structure before and after replacement of elastomeric bearings.

Under Progress

Structural Health Monitoring for Bridge No. 248 – Rajahmundry Bow String Arch Bridge (East Coast Railway - India)

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Overview of Structure

The III-Godavari Bridge consists of PSC boxes with Bowstring arches and having 28 spans of 97.552m each. The bridge was opened for rail transport in 1997. The prestressed box is connected to the twin RCC arches by means of 12 DINA hangers. The bridge is one of the iconic constructions built across Godavari bridge on Kovvuru Rajhamundry section.

Objective of Project

The Structural health monitoring of Godavari bridge is emphasized to understand the condition of several structural members like DINA hangers, RCC arches, irregularities/distress in the Cables, calculate cable force, check the profile of members, camber measurement, check excessive moments, vibrations, loss in prestress forces etc.

Scope of work

Visual inspection of bridge. Checking existing profile of superstructure i.e., Arch, Tie girder & compare with original profile. Strain in all DINA Hangers and observations of expansion/contraction during live loads at different speeds of passenger and Goods trains to assess the behavior of Hangers. Measuring existing camber, bearing moments and checking with design standards. Carrying out Ambient Vibration Test (AVT) using Tri Axial Accelerometer sensors to record the vibrations of deck, Deflections / displacements of Deck & Soffit slabs of Tie Girder at different loading conditions at different speeds and Observation of Tilt on Piers.

KDM ENGINEERS GROUP

Complete Civil Engineering Solutions

KDM ENGINEERS GROUP is a premier Civil Engineering organization, established with an aim to bring Civil Engineering Consultancy & Services including Training under one roof and to become a center of excellence and approachable for the construction industry.

The KDM Engineers Group has two wings namely, **KDM ENGINEERS AND CONSULTANTS PRIVATE LIMITED and KDM ENGINEERS (INDIA) PRIVATE LIMITED.**

KDM ENGINEERS AND CONSULTANTS PVT. LTD (KDMECPL) is a consulting firm established in 2018, with demonstrated experience in preparing Detailed Project Reports (DPR), Detailed Value Engineering Works, Pre-Bid services, Authority/Independent Engineering Services etc.

KDM ENGINEERS (INDIA) PVT. LTD (KDMEIPL) is a multi-disciplinary Engineering Services and consulting firm established in 2012, with demonstrated experience in Engineering Surveys and Investigations, Construction Materials Testing, Mix Designs, Structural Rehabilitation, and Training.

KDM ENGINEERS (INDIA) PVT. LTD (KDMEIPL) is accredited by NABL for its wide range of testing facilities in Mechanical and Chemical fields as per ISO/IEC: 17025 – 2017, based at Hyderabad (TS) with branches at Guntur and Visakhapatnam (AP), and establishing a new branch at Tirupati.

KDM KNOWLEDGE SHARE CENTRE (KDMKSC) is to educate and impart the knowledge and practice of latest technological developments for meeting the industry requirements through refresher courses on specific areas.

KDMKSC draws upon Resource persons from **KDMEG**'s Engineers and Technologists and other experts having rich and valuable experience, in all aspects of construction technology.

KDMEG adopts a well-structured quality assurance and management, with a strong commitment, to provide complete solutions to the clients. The **KDMEG** endeavors to keep up relentless efforts in finding the optimal and quality solutions.

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