Intelligent Monitoring of Infrastructures

Iran University of Science and Technology
School of Railway Engineering

IUST

Intelligent Monitoring
of Infrastructures

Today, load testing and bridge monitoring are among the most important approaches to measure the structural behavior of a bridge. Structural health monitoring, damage detection and load carrying capacity assessment can be performed through the test. The operation is appropriate for current, newly constructed and strengthened structures. The Intelligent Monitoring Labratoary with a record of ten years experience has the capability to offer a suit of services for permanent and temporary structural health monitoring of different type of in-service or newly constructed road/railway bridges. Recently, Condition assessment with advanced technologies is among the active researches in the lab.

Structural Health Monitoring Procedure

- Preliminary visual inspection of structure and as-built plans
- Initial Computer Modelling
- Designating loading schemes and sensor positioning
- Instrumentation
- Dynamic load testing
- Measurement And Data Acquisition
- Information Transfer
- Signal Processing
- Calibration
- Bridge Capacity Assessment
- Structural Health Monitoring Report

1. Dynamic load testing of road/railway bridges

S Bridge
(Northwest Region)

Veresk Bridge

Neka Bridge

Saleh Hamid Bridge

Ghotour Bridge

Ghaleh Morghi
Bridge

Bridge Km-475
(Northwest Region)

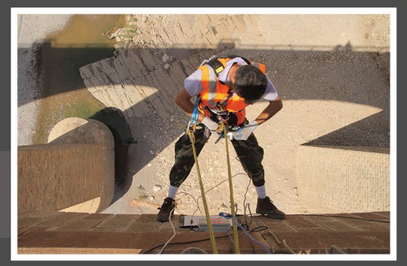
Toove Bridge
Zagros region

Demdem Bridge
Zagros Region

Bridge Km-487
(Northwest Region)

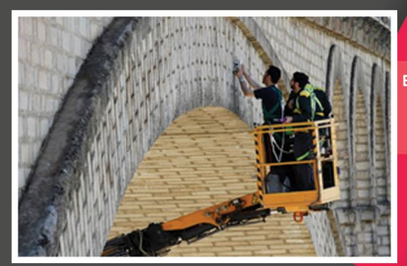
2. Accessing different bridge elements for inspection and instrumentation

Rope Access
Equipment
S bridge



Bridge Inspection
Vehicle
Veresk Bridge

Construction
Framwork
Ghaleh Morghi
Bridge

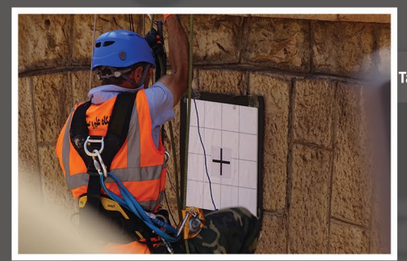


Bridge Inspection
Vehicle
Veresk Bridge

Crane
Ghotour Bridge

Bridge Inspection
Vehicle
Saleh Hamid
Bridge

Mountain Tools
Karaj Bridge



Target Installation

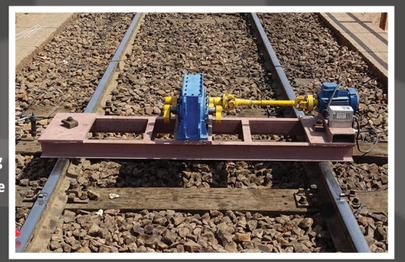
3. Field Load Testing (Truck, Train, Impact, Shaker, Ambient)

Impact Loading
Neka Bridge

Train Loading
Ghotour
Bridge

Train Loading
S Bridge

Shaker Loading
Shahbazi Bridge



Train Loading
Tooveh Bridge

Static Loading
Mohammad
Abad Bridge

Truck Loading
Ghaleh
Morghi Bridge

Train Loading- Karaj Bridge Km38

4. Instrumentation with displacement, strain, and vibration sensors

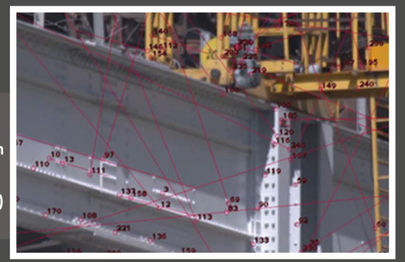
Joint opening
measurement
with LVDT

Displacement
measurement
with DCDT

Crack Opening
with strain
gauge

Strain
measurment by
strain gauge

Displacement
measurement with
photogrametry
(Image Processing)



Displacement
measurement with
photogrametry
(Film Recording)

Vibration
Measurement with
Accelerometer

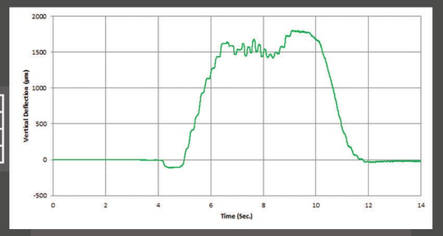
Vibration
Measurement
with
Seismometer

Vibration
Measurement with
Accelerometer

Vibration
Measurement
with
Seismometer

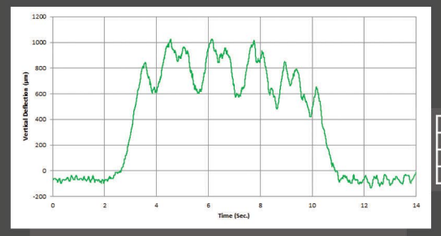
5. Displacement Data & Vibration Signal Processing

Veresk
2Diesel + 2Wagon
760 Tons
48 Km/h



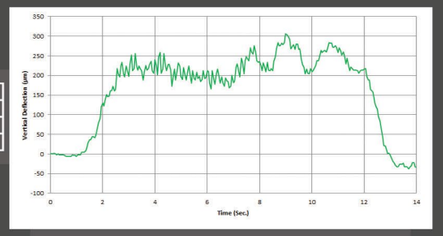
Vertical Displacement of the middle of main span
Span Length: 66m

Saleh-Hamid
3Diesel + 2Wagon
760 Tons
46 Km/h



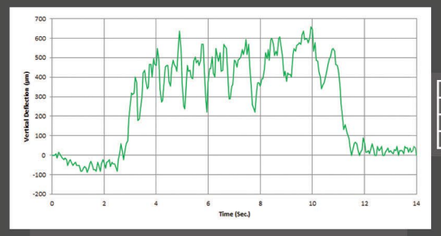
Vertical Displacement of the middle of main span
Span Length: 40m

S
3Diesel + 5Wagon
760 Tons
46 Km/h



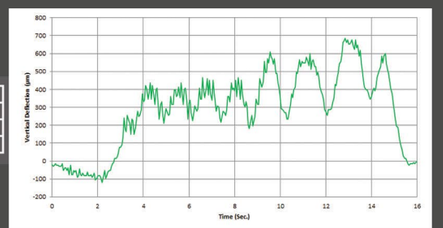
Vertical Displacement of the middle of main span
Span Length: 36m

Tooveh
3Diesel + 5Wagon
760 Tons
59 Km/h



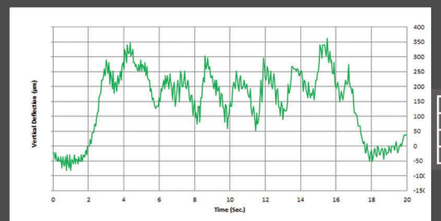
Vertical Displacement of the middle of main span
Span Length: 30m

Km 475 NorthWest
3Diesel + 5Wagon
760 Tons
40 Km/h



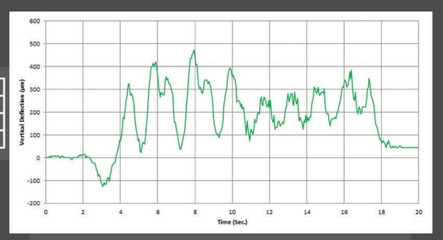
Vertical Displacement of the middle of main span
Span Length: 25m

DemDem
3Diesel + 5Wagon
760 Tons
34 Km/h



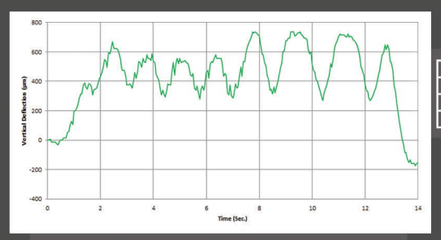
Vertical Displacement of the middle of main span
Span Length: 21m

Km 564 NorthWest
3Diesel + 5Wagon
760 Tons
34 Km/h

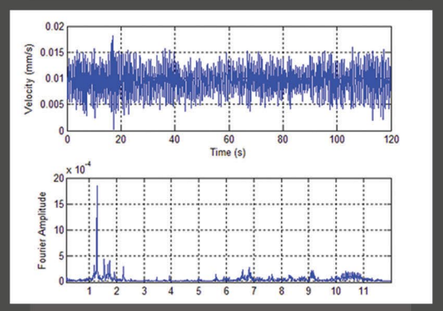


Vertical Displacement of the middle of main span
Span Length: 11m

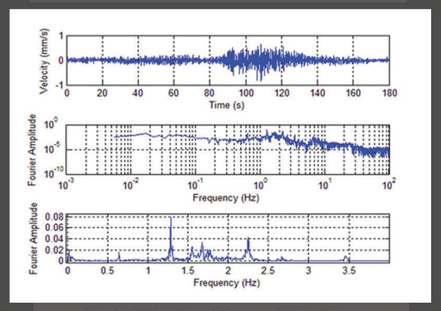
Km 475 NorthWest
3Diesel + 5Wagon
760 Tons
40 Km/h



Vertical Displacement of the middle of main span
Span Length: 8m



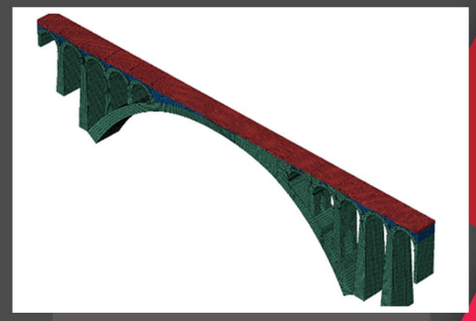
Vertical Velocity of Ghotour Bridge due to Ambient Vibration



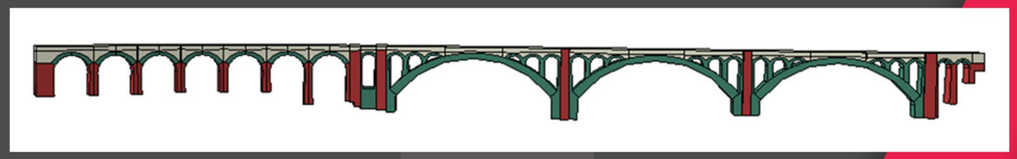
Vertical Velocity of Ghotour Bridge due to Train Passage

6. Finite Element Model Calibration and Load Capacity Assessment of Bridges

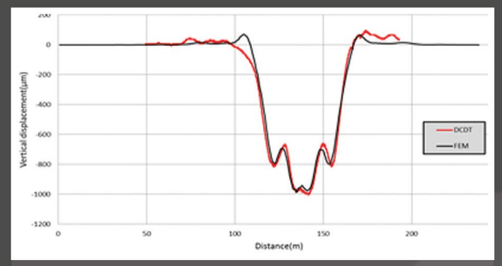
Saleh Hamid Bridge



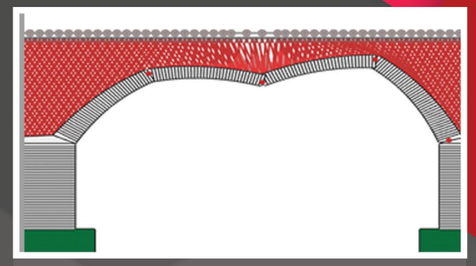
Veresk Bridge



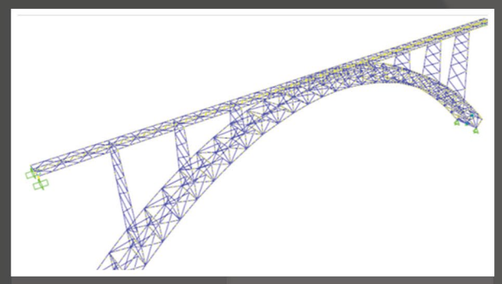
S Bridge
(Northwest Region)



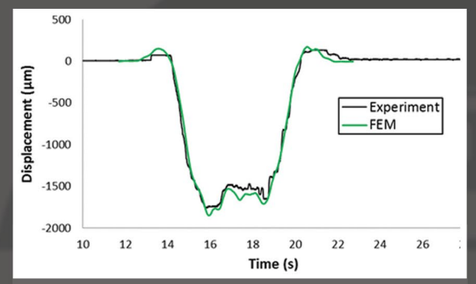
Comparison of Updated Finite Element Model and Field Test Result-Saleh Hamid Bridge



Ultimate Load Capacity Assessment of Saleh Hamid Bridge with The Ring Software



Ghotour Bridge Finite Element Model



Comparison of The Updated Finite Element Model and The Field Test Result-Veresk Bridge

Cost Estimation of Bridge Dynamic Testing

	Length of Main Span (Meter)	Less than 20	Less than 30	Less than 40	Less than 200
	Total Length of Bridge assuming bridge width is less than 10 Meter (Meter)	Less than 40	Less than 100	Less than 150	Less than 500
	Number of Sensors	Less than 6	Less than 10	Less than 20	Less than 30
	Number of Team Members	At least 3	At least 4	At least 5	At least 6
	Number of Days	1 Day	2 Days	3 Days	4 Days
1	Cost of visual inspection and As-built plan validation	Man Day 1	Man Day 1	Man Days 2	Man Days 3
2	Preliminary Modelling, Test Design and Determination of type and location of each sensor, Model Updating, Bridge Assessment and Submitting Final Report	100 Hours	200 Hours	300 Hours	500 Hours
3	Vibration and Displacement Data Processing and Submitting Final Report	100 Hours	200 Hours	300 Hours	500 Hours
4	Commuting and transportation	Depend on The bridge location			
5	Accommodation	Depend on The bridge location			
6	Accessibility to the installation of sensors position	Depends on deck accessibility, possibility of installing temporary steel framework, or employing bridge monitoring vehicle.			
7	Sensor Installation and calibration as well as data acquisition, providing documentary through taking pictures and film recording.	Depends on type and quantity of sensors, length of cables, accessibility, etc..			
8	Weighting and load testing	It depends on load testing procedure and the test train			
9	Hiring facilities	It depends on the number of facilities			
10	Other fees	Including, but not limited to, tax, insurance, etc.			

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