Monitoring structures for a safe and productive world

Intro and Overview for Structural Health Monitoring and Bridges

Christopher Kavars
SENSR, LLC.


LOST
CONFUSED
UNSURE
UNCLEAR
PERPLEXED
DISORIENTED
BEWILDERED


SNAKE OIL
ORIGINAL FORMULA
Structural
Health Monitoring
CURES FOR WHAT AILS YA•ACCEPT NO SUBSTITUTES

Structural Health Monitoring – Los Alamos

The process of implementing a damage identification strategy for aerospace, civil and mechanical engineering infrastructure. Damage is defined as changes to the material and/or geometric properties of these systems, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance.

Structural Health Monitoring - Origins

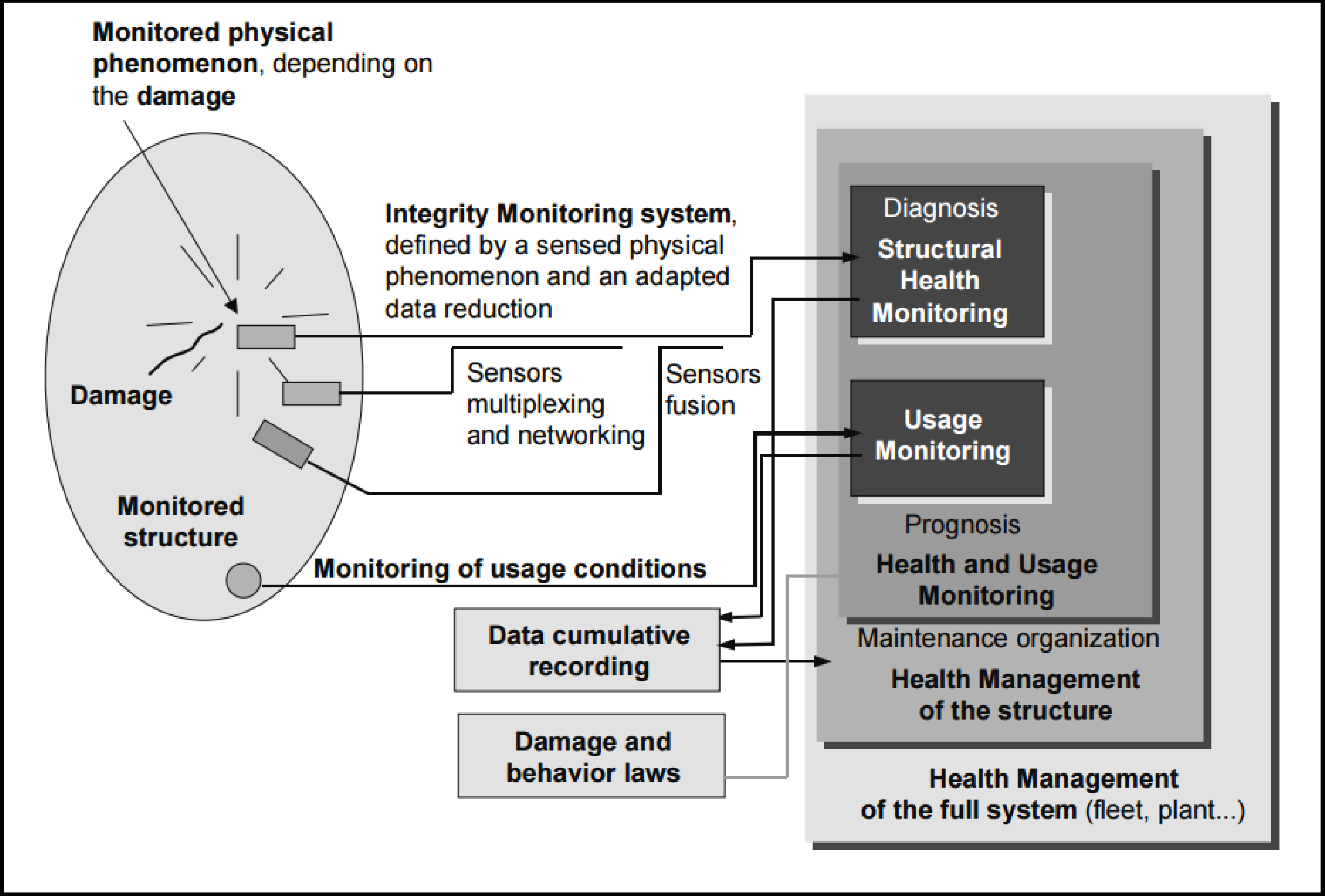
Structural Health Monitoring – Birthing Environment

- Heavy use of instrumentation and analysis to determine performance
- Short to medium service life
- Mass-produced products
- Established life-cycle management programs

Structural Health Monitoring – Contributors

Condition Monitoring	**Non-destructive Evaluation**
Statistical Process Control	**Damage Prognosis**

Structural Health Monitoring – 40 years of Evolution



Structural Health Monitoring – Bridge Environment

- Very long service life

- Most damage progresses slowly and indications of damage are usually visual.

- Highly varied population

- Sensor-based damage detection techniques are not fully developed or accepted.

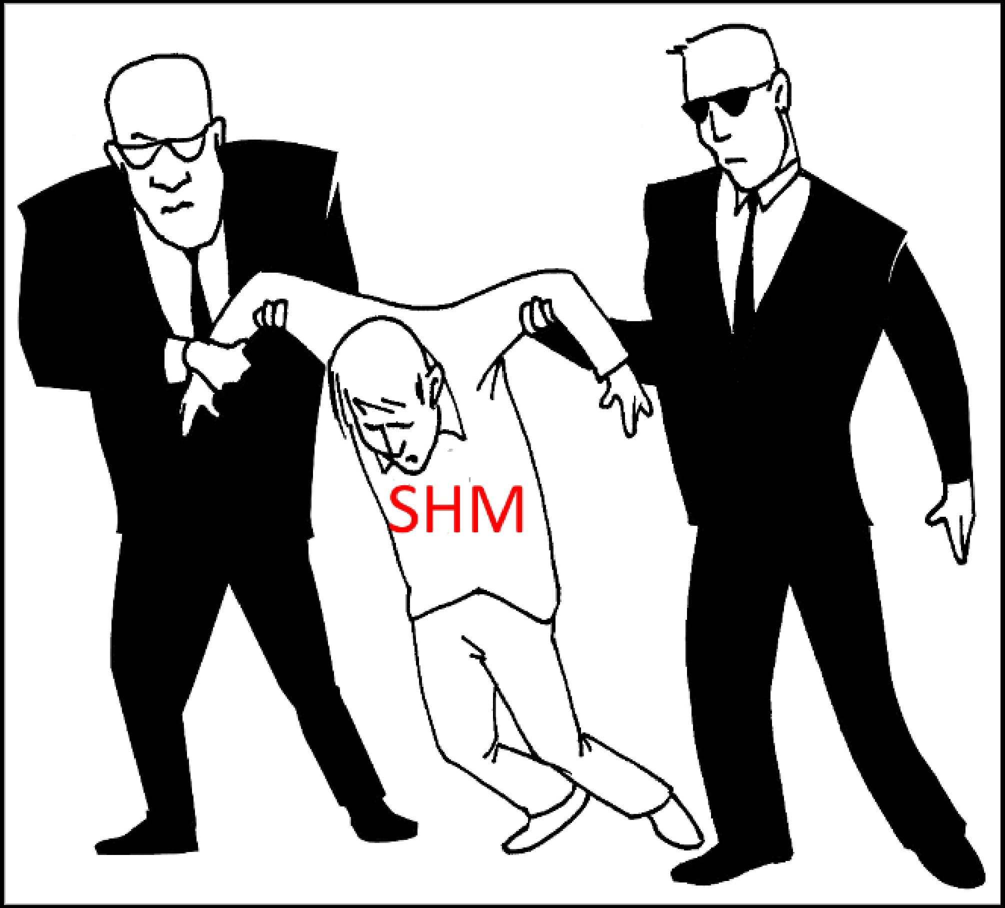
Structural Health Monitoring – Bridge Monitoring

Measure

Meaning

Result

Structural Health Monitoring – Bridge Monitoring



Structural Health Monitoring – Bridge Monitoring

- Developing applications

- Scaling applications

Bridge Monitoring – scaling SHM programs

- A problem may exist but confirmation is difficult to determine.

- A problem may develop if a specific set of driving circumstances occur

Structural Health Monitoring – Substructure Monitoring

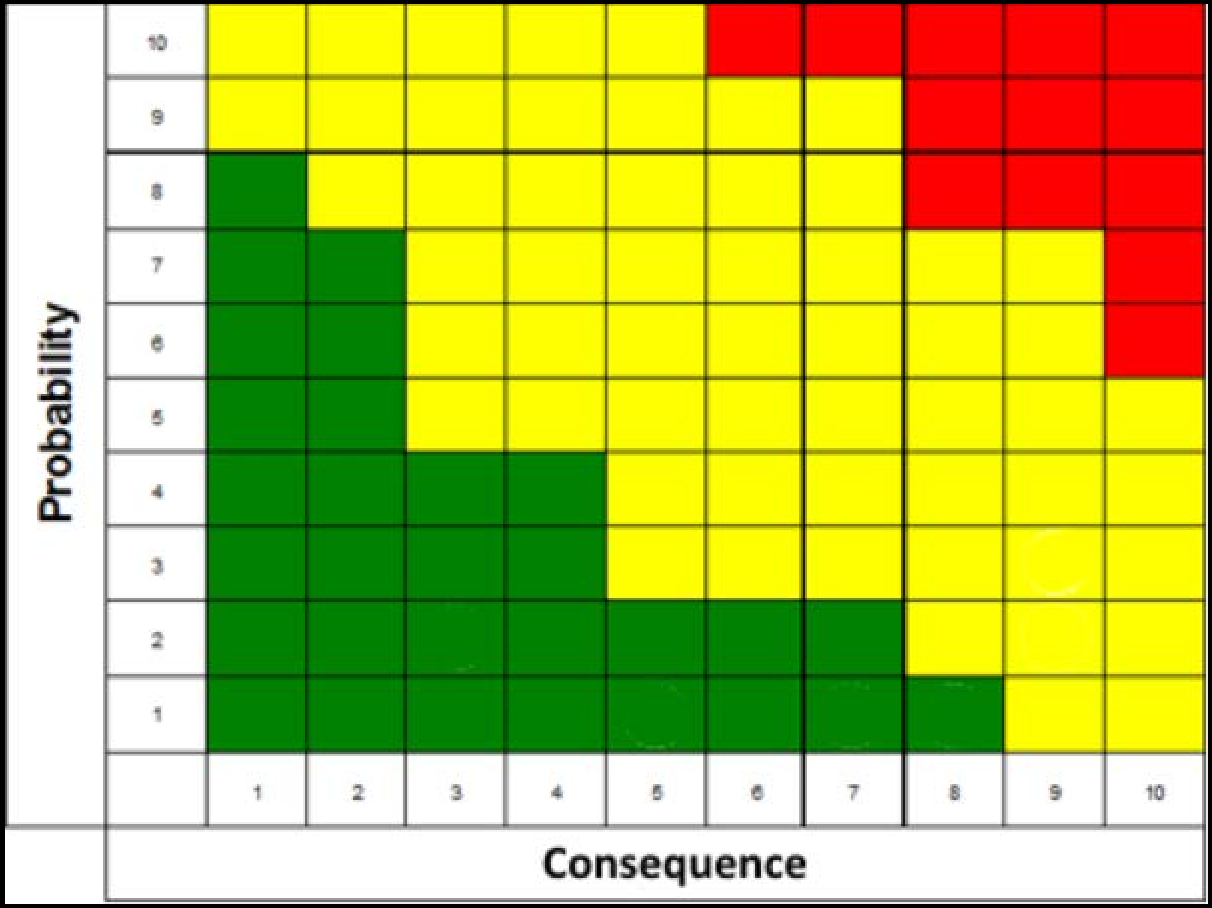
Scour, collision detection, settlement / subsidence, masonry crack propagation, adjacent construction damage, and bearing functionality.

Structural Health Monitoring – Deck and deck support monitoring

Vibration monitoring, crack propagation, strain monitoring, load monitoring and chloride intrusion

Structural Health Monitoring – 3 requirements for success.

1. Risk analysis has to show the need.



Structural Health Monitoring – 3 requirements for success.

2. Parameter that assessments can be based upon.

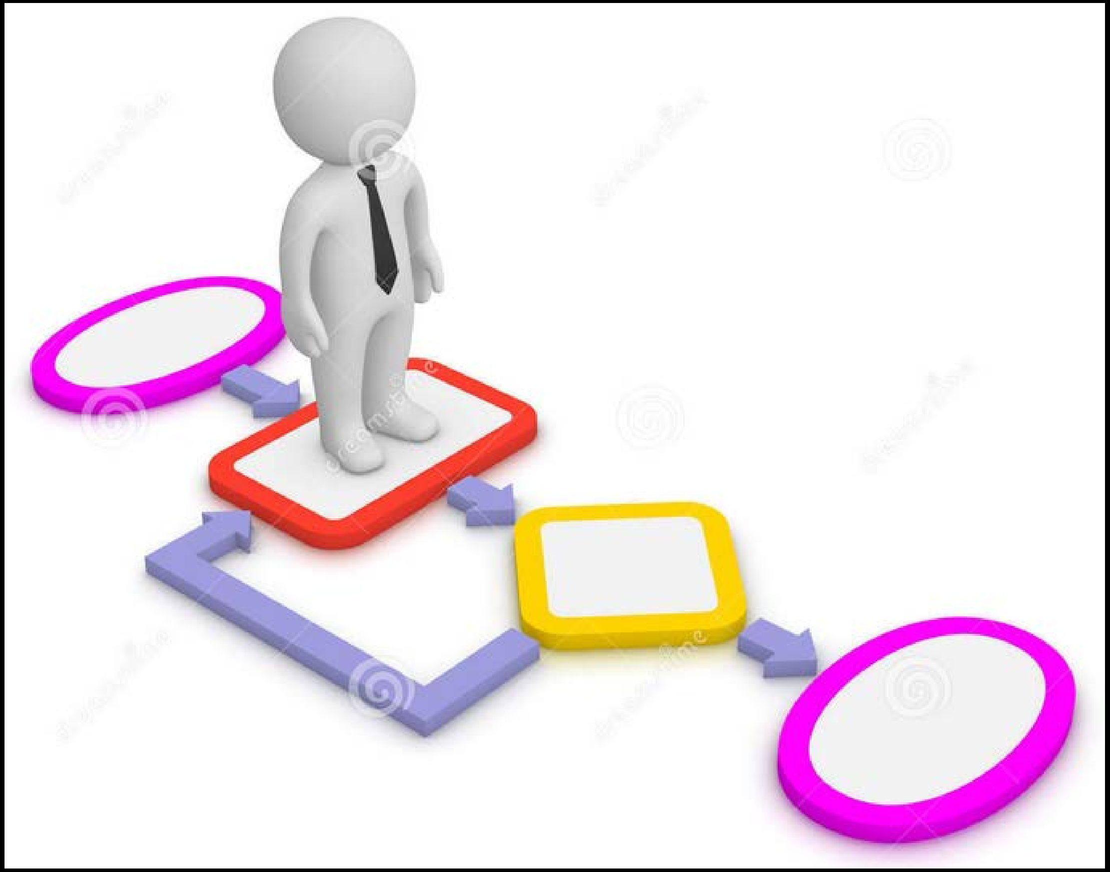
SI Derived Units

Derived Quantity	Name	Symbol	Equivalent SI units
Frequency	hertz	Hz	s^{-1}
Force	newton	N	$m \cdot kg \cdot s^{-2}$
Pressure	pascal	Pa	N/m^2
Energy	joule	J	N·m
Power	watt	W	J/s
Electric charge	coulomb	C	s·A
Electric potential	volt	V	W/A
Electric resistance	ohm	Ω	V/A
Celsius temperature	degree Celsius	°C	K*

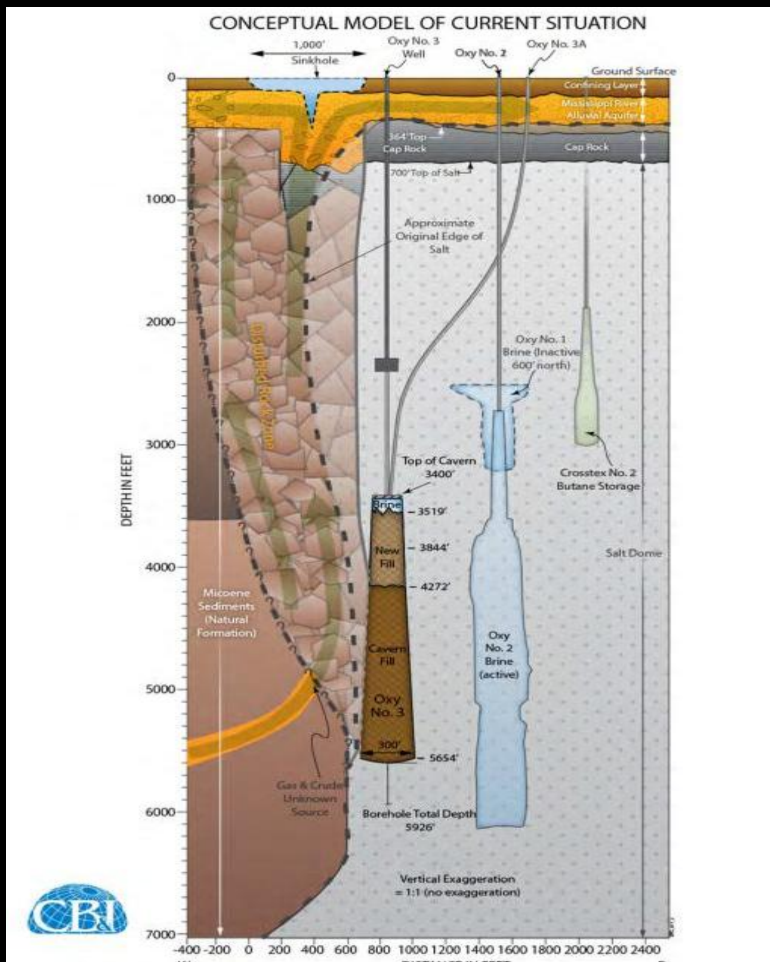
*Unit degree Celcius is equal in magnitude to unit kelvin.

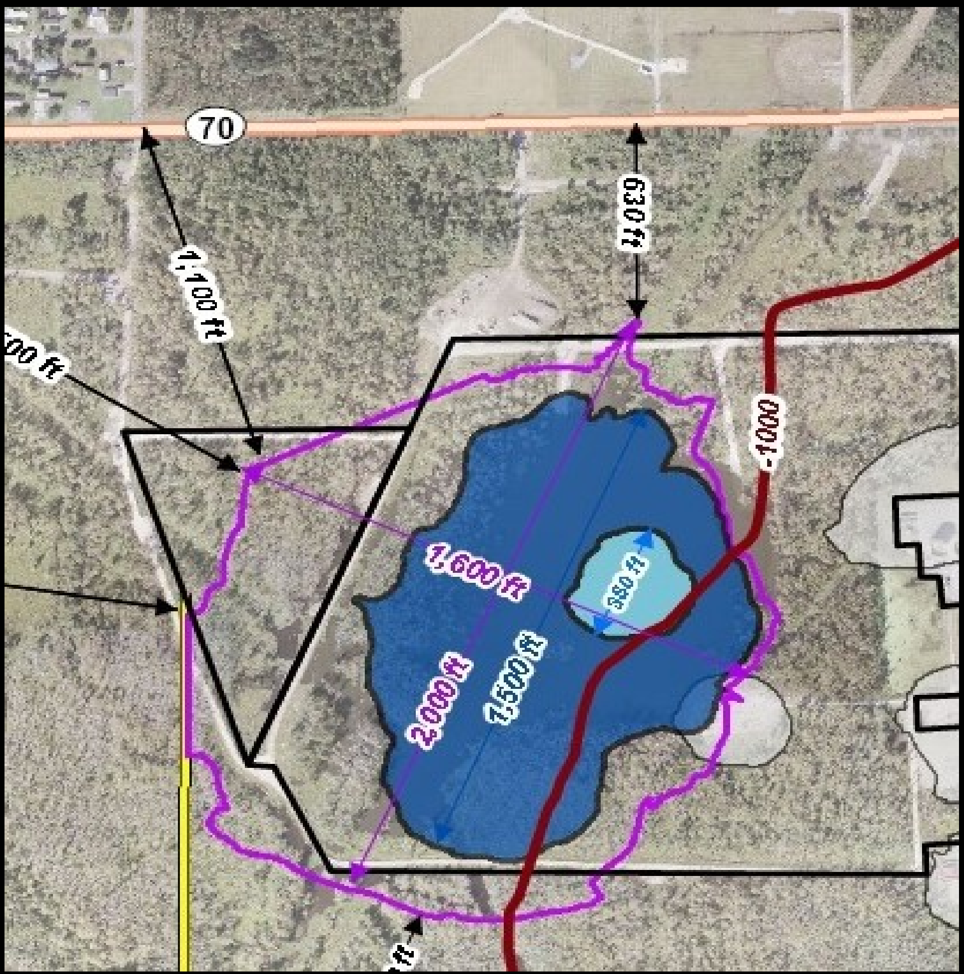
Structural Health Monitoring – 3 requirements for success.

3. Know what to do when measurements or trends are realized.



LADOTD – Bayou Corne Sinkhole

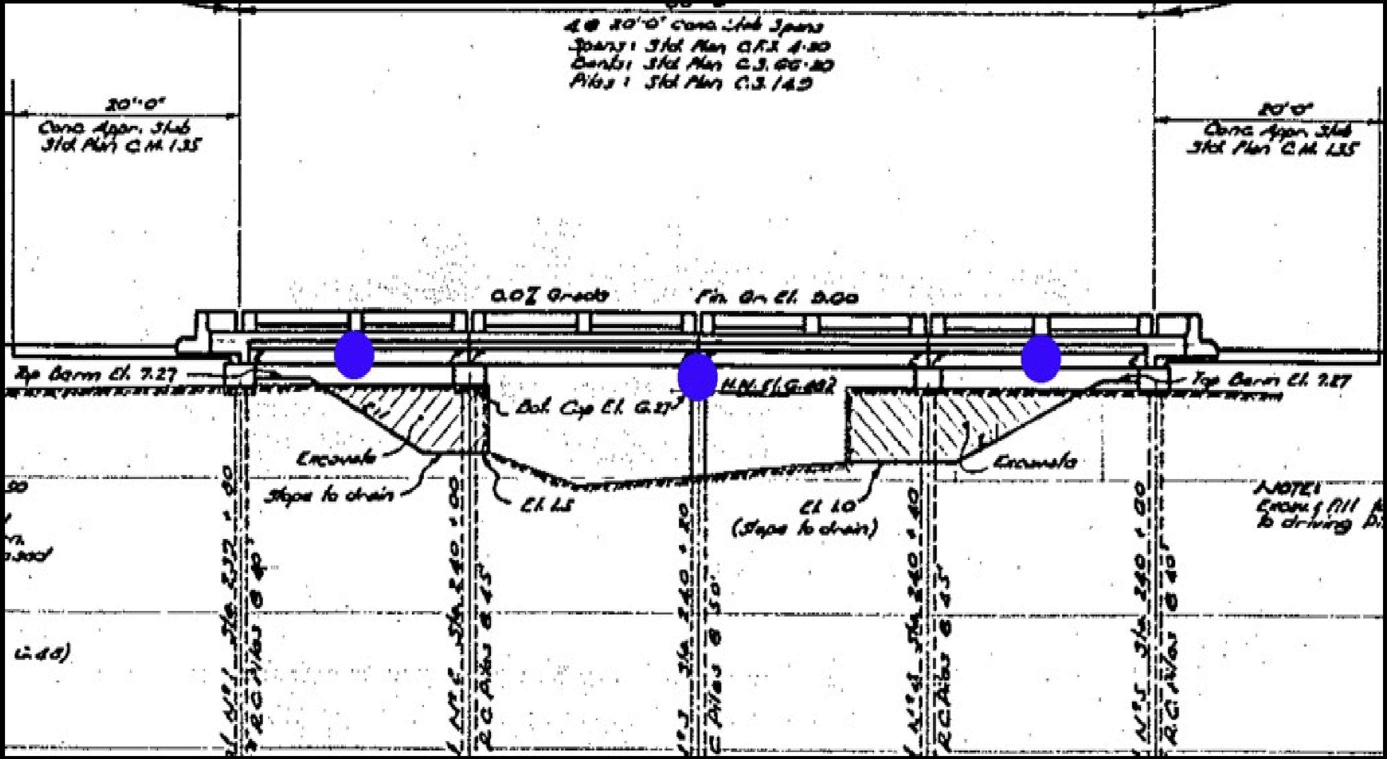




LADOTD – Bayou Corne Sinkhole

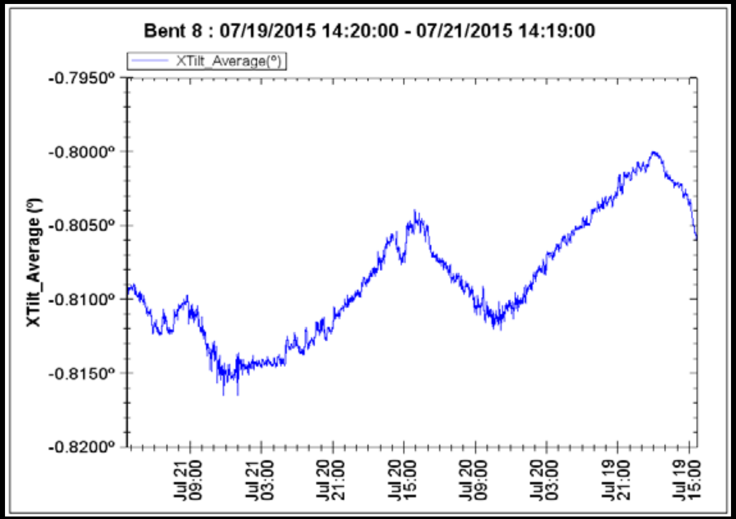
LADOTD – Bayou Corne Sinkhole

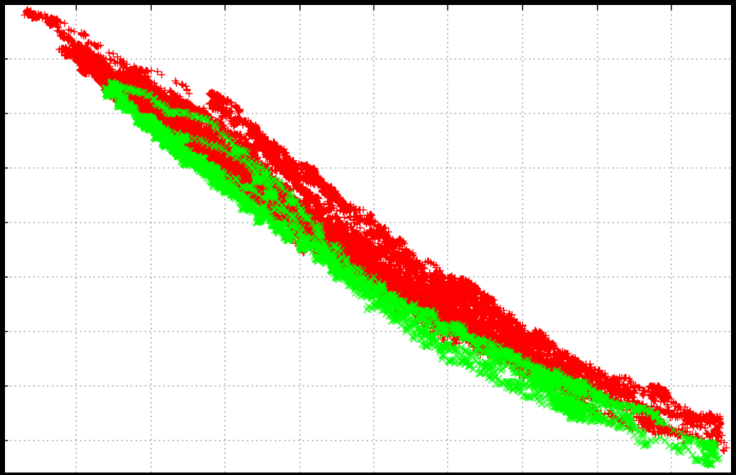
LADOTD – Bayou Corne Sinkhole

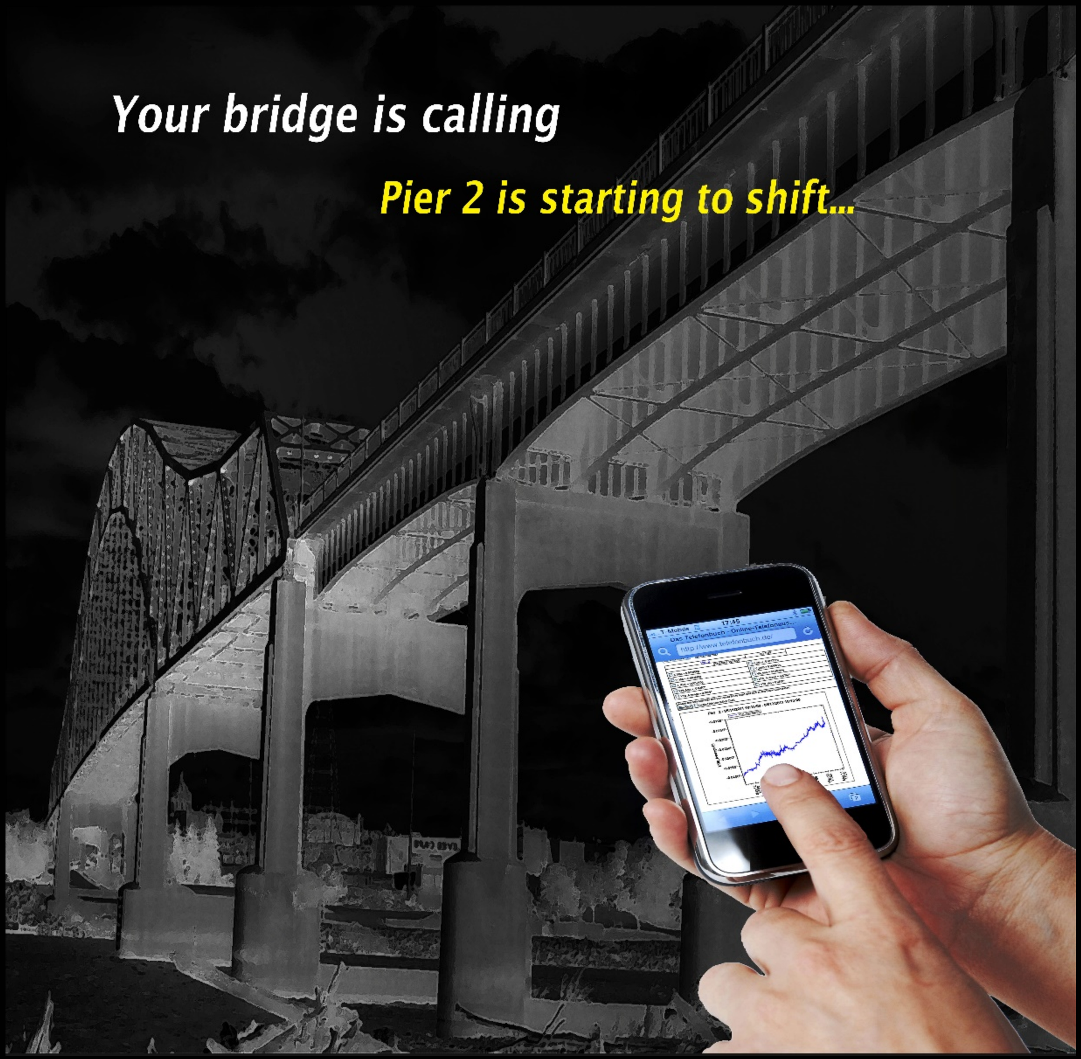


3 – axis accel
2 – axis tilt
1 – temp

LADOTD – Bayou Corne Sinkhole







Scaling Bridge Monitoring programs

- Detection and notification of an undesirable event – Collision

- Detection and notification of an undesirable behavior – pier tilt related to scour

Structural Health Monitoring

Thank You