Practical Considerations For Aging Towers
(and not so aged ones!)

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Some Content and Photos Courtesy of Craig Snyder, Sioux Falls Tower Service, Past President of N.A.T.E. & David K. Davies, Consolidated Engineering

DISCLAIMER

This presentation consists largely of the opinions of the author (s).

- **It is not intended to provide specific engineering advice for any particular situation.**
- **You should engage the services of a qualified engineering firm before making any decisions about your tower.**
- **Operation and maintenance of your tower system is a dynamic situation based on many manmade and natural (weather) inputs.**
- **Drawings, photographs and exhibits used herein are used as learning tools only and are not the authors opinion of any specific cause and / or effect.**
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NOTHING HAPPENS UNTIL IT HAPPENS TO YOU

A Novel Without Pay, Perks, or Privileges

T. M. SHINE

Accidents & incidents, involving towers, are typically a confluence of circumstances of sometimes seemingly unrelated events, which all coalesce to create a disaster.

TOP 5 CAUSES OF BROADCAST TOWER FAILURE

50 Year Study Period

- **Construction / Erection Errors** **31%**
- **Ice Accumulation** **29%**
- **Special Wind** **19%**
- **Aircraft Strikes** **11%**
- **Anchor Failure** **10%**

Source: Consolidated Engineering, Inc.
David K. Davies
Used With Permission

Prevention is - cheap
Fines & lawsuits – aren't

Don’t get caught on stupid stuff, follow the rules, think of them as “hints” ***(from Chris Rock)***

If required on your site;

- **Keep lights working**
- **Keep it painted (if required)**
- **Keep fences in order and locked**
- **Keep required signage current and posted**
- **Keep other signs posted; e.g. “No Trespassing”**
- **Keep FCC & FAA paperwork current & posted**
- **Keep FCC & FAA notified of changes / outages**

My Point – In black & white

Broadcast LAW BLOG

Broadcast Law Blog

Posted at 1:44 PM on March 19, 2013 by David Oxenford

$14,000 FCC Fine for Tower Violations - Obstruction Light Out, No FAA Notification and Failure to Update Antenna Survey Registration to Report New Owner

In a Notice of Apparent Liability, the FCC proposed **a $14,000 fine** on a broadcaster for a series of violations with respect to its tower. The FCC found that the station **failed to have the required lights on the tower operating after sunset** on at least two days, **failed to notify the FAA of the outage** (so that the FAA could send out a NOTAM – a notice to "airmen" notifying them to beware of the unlit tower), and **failed to properly register the tower when the current owner acquired the station** from its previous owner. As the tower had been sold over 3 years prior to the inspection that discovered the tower lights being out, the FCC determined that the violations were particularly egregious, and upped the fine - which would have been $10,000 for a failure to have the lights operating, and $3000 for failing to update the Antenna Structure Registration ("ASR") by an additional $1000. As noted below, updating tower registrations is considered very important by the FCC as, in another recent decision, the FCC proposed a $6000 fine merely for the failure of a licensee to update a tower registration.

If you treat your transmitter air filter like this, how long are you going to be on the air?

Why would you treat the outside half of your transmitter plant with any less care?

Every System Requires Preventative Maintenance

Your Body

- Annual Physical
- Eyes / glasses checked
- Cancer screening
- Teeth cleaning / dentist

Your Tower(s)

- Lighting checkup
- Physical inspection
- Transmission line checks
- Guy wire tensions
- Lightening protection check
- Signage, gates, locks

ADVANCING GLOBAL COMMUNICATIONS

	First Annual	Every Year	Every 3 Years[1]	Every 5 Years[1]	After Severe Loading Condition
Tower Shaft –Guyed (Visual)	X	X		X	
Tower Shaft–SS (Visual)	X	X		X	
Tower Shaft –Guyed (Climbing)	X		X		X
Tower Shaft –SS (Climbing)	X			X	X
Vertical Alignment–Guyed	X		X		X
Vertical Alignment–SS	X			X	X
Guy Wires (Visual)	X	X			X
Guy Wires (Tension Meter)			X		X
Foundations–Guyed	X		X		
Foundation - SS	X			X	
Lighting System[2]	X	X			X
Ground System	X	X			X
Elevator	X				X

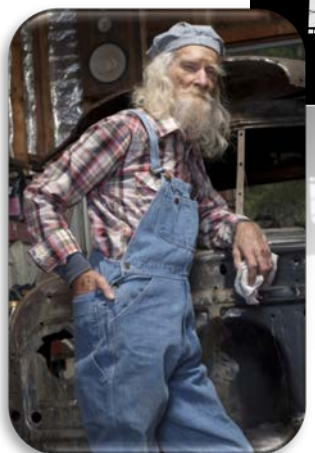
[1] *TIA/EIA 222-G recommends that maintenance and condition assessments are performed every three years for guyed towers, five years for self-supporting towers and after severe wind and/or ice storms. A shorter interval is recommended for towers in coastal regions and for Class III structures.*

[2] *As outlined in FAA Circular AC70/7460-1K.*

From Urgent Communications Magazine

When I started in the broadcast business in the 60's, we did lots of things we shouldn't have! I'm lucky to be alive. (Mark Allen)

- Climbing without belts
- Working on hot AM towers
- Fixing lighting wiring, at night
- Working during thunderstorms
- Adding antennas, lines, etc. without consideration
- Tightening guys with no instruments
- More stuff I won't admit to!



<u>Any time</u> you are considering modifications to your towers, you should engage the services of a qualified engineer or consulting firm.

Construction / Modification Errors Account For 31% of All Tower Failures. #1 Single Cause!

- Select your steeplejack carefully !
- Check their qualifications & experience
- Make sure their experience is appropriate for your size & type of tower
- Check reputation
- Check insurance
- Discuss a work plan with the supervisor
- Plan on being on site during work

Maybe We Need To Check Our STL Path Alignment

But Boss – We Saved $2500 By Skipping The Engineering Soils Report

A Word About Professional Geotechnical Reports

When are you considering a new or replacement tower, ALWAYS…..that means ALWAYS….get a reputable geotechnical report;

1. **An engineers foundation calculations are no good without accurate soils data.**
2. **Resultant finished foundations may not support anticipated loads**
3. **Bad things that can happen:**
   - **Foundation cracks**
   - **Foundation shifts**
   - **Overturning loads not supported**
   - **Guy points shift**
   - **Guy points move vertically**

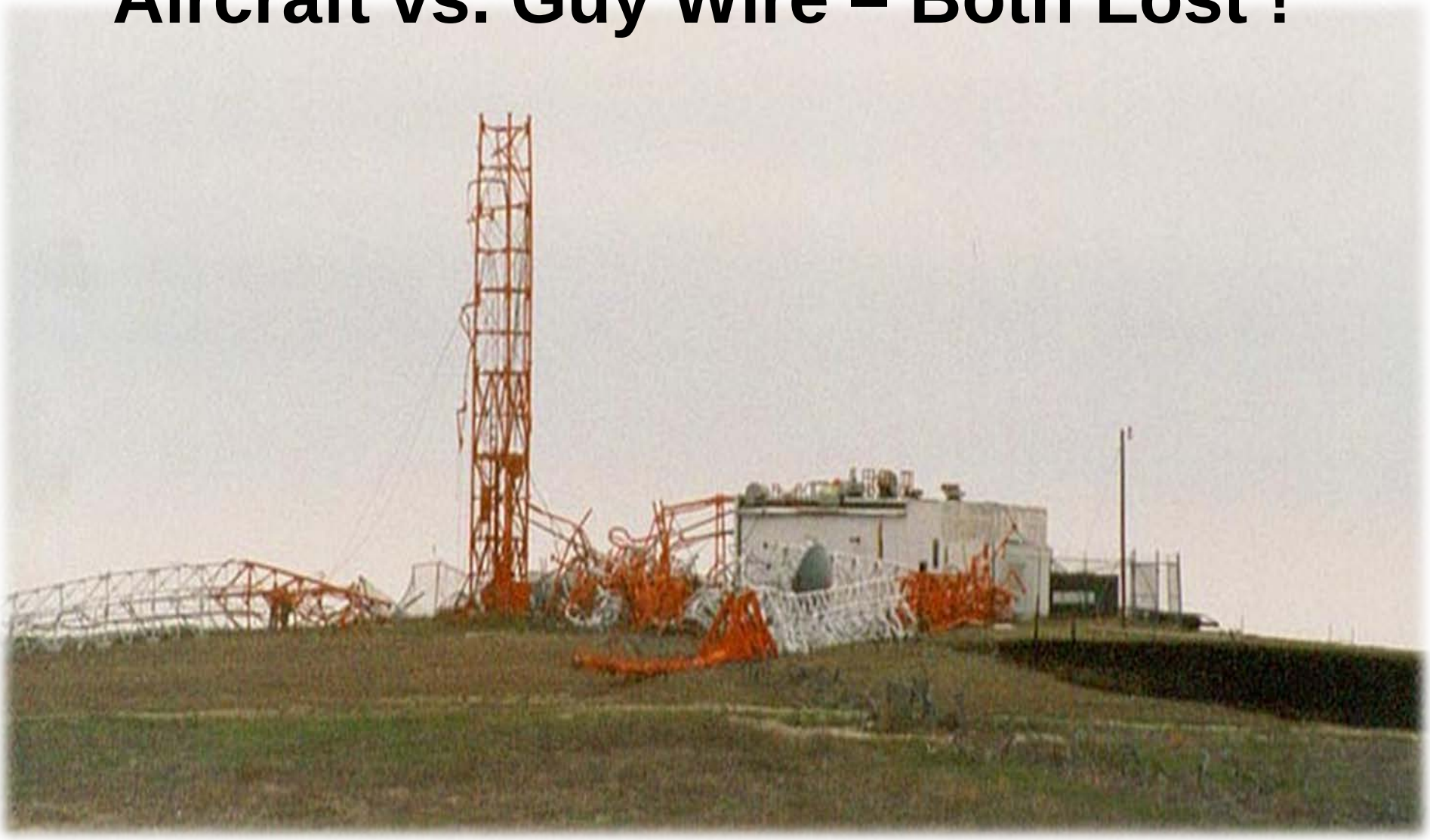
Oops – Just Got Worse

If An Aircraft Strikes Your Tower-

- **Every federal and local agency with a badge you can dream of will build a tent in your lobby and be examining you and your installation under a microscope.**
  - Are the permits in order?
  - Paint job compliant?
  - Lighting working? How do you know?
  - At the right LAT/LON?
  - FCC compliant per license?
  - FAA compliant per permit?
  - Structure registered? Correct Info?

- Plan on getting sued, involve your insurance company & lawyer from the start.
  - Maintenance records
  - Inspection and compliance records

Something Like This Is The Most Likely Outcome
Aircraft vs. Guy Wire – Both Lost !



Sabotage & Vandalism

Think It Just Can't Happen To You?

Examiner.com

Vandals suspected of destroying a communications tower in Northern California

LOCAL TRAVEL | JULY 31, 2013 | BY: RICK DEUTSCH

Communications tower collapse believed to be vandalism.
Credits: East Bay Regional Parks

The San Francisco (http://www.examiner.com/topic/san-francisco) Bay area is the home to four million people. They are connected to the communications grid by multiple towers that hold relay antennae for TV, Radio, 2-way, cellular, microwave links and ham radios. On the early morning of July 29, the affluent Contra Costa county town of San Ramon (http://www.examiner.com/topic/san-ramon) , CA found many services disrupted due the collapse of a 200-foot high tower. The tower is an important communications hub in the Contra Costa and Alameda counties.

RELATED TOPICS

- Local Travel (http://www.examiner.com/topic/local-travel)
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There are no suspects at this time. It's pretty certain that the fall was not caused by fatigue or weather. The towers are inspected regularly and the area is enjoying mild days with normal five knot winds. Authorities said the it appeared the supporting guy wires were cut, causing it to collapse with a loud crash.

Many antennae are located on the high peaks surrounding the San Francisco Bay. The authority that manages the parklands where this tower is located is the East Bay Regional Park District. The tower is specifically located on Rocky Ridge. It's west of the towns of San Ramon and Danville. Police said that the vandalism was noticed once services were disrupted.

Fabrication Induced Failures

LESSON: Use an Experienced Manufacturer

- AISC Certified Steel Fabricator
- AWS and CWB Certified Welding Fabricators

AMERICAN INSTITUTE OF STEEL CONSTRUCTION INC. AISC FOUNDED 1921

CWB CERTIFIED

QUALIFICATIONS

Structures Should Be Hot Dip Galvanized (After Fab)

By an ASTM 123 Certified Facility

QUALIFICATIONS


What Are Two Key
Elements Affecting
Your Tower System?

Mother Nature

Father Time

Were You Thinking of the # 2 Reason Towers Have Catastrophic Failures

29% of Tower Failures Start Like This

Tornado Induced Failure
(aka – “Special Wind - #3 Cause of Failure)

Lack of Even One Guy Wire Is Definitely Not Good !

(aka - # 5 Cause of Failure)

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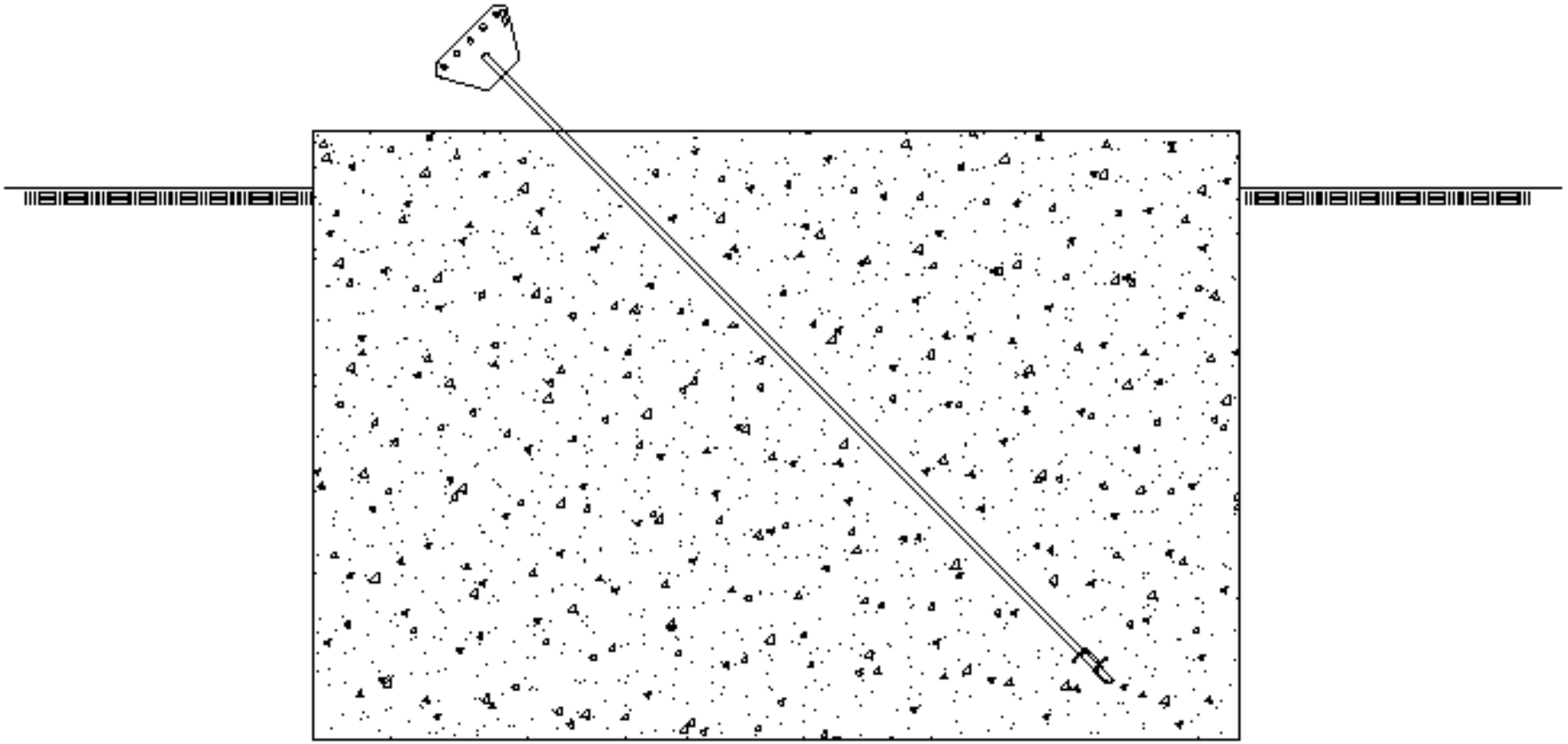
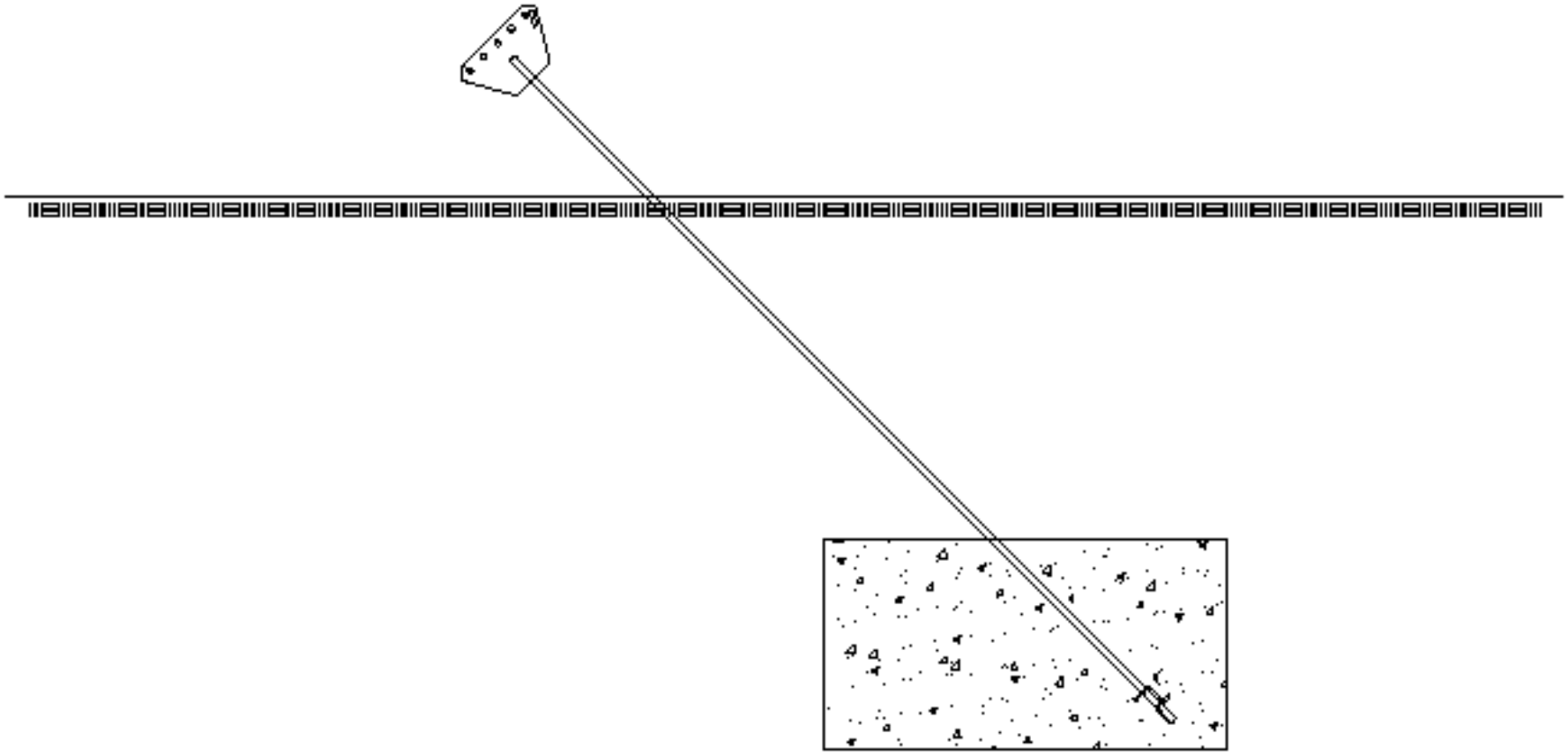
Typical Guyed Tower Anchor Foundation Up Until Mid – 1960's



Typical Guyed Tower Anchor Foundation After Mid – 1960's



Failed Anchor - Wonder What the Others Look Like ???

Wonder What the Others Look Like? Exact Age Unknown, Believed Less Than 15 Years Old.

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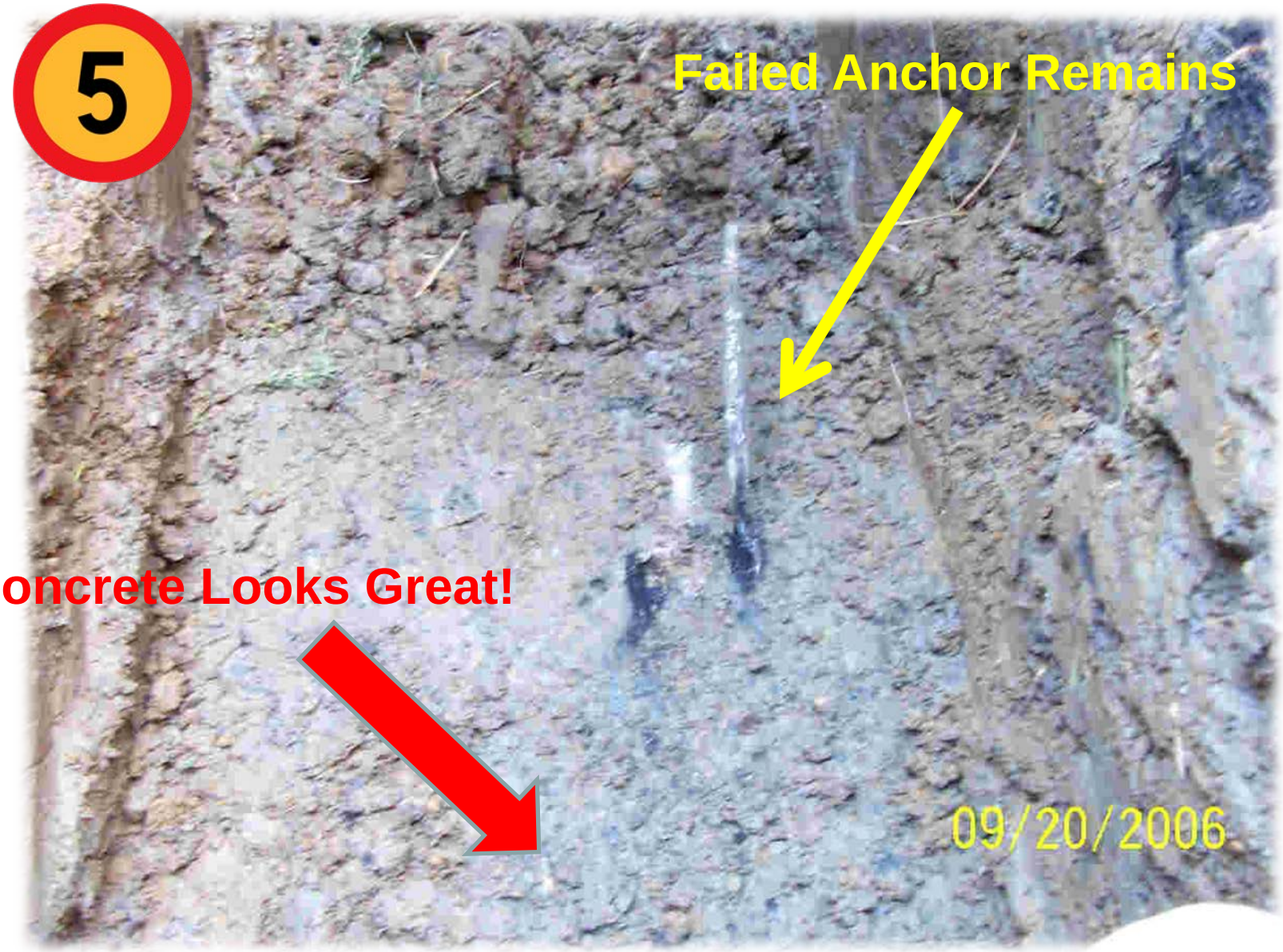
Wonder What the Others Look Like ??



Preventive Measures
aka – You Can Be Proactive

- **Corrosion Risk Assessment**
- **Ultrasound Testing**
- **Physical Inspection**

Seek the Services of a Corrosion Specialist, inspections can be very inexpensive compared to any failure.

NACE®
INTERNATIONAL
THE CORROSION SOCIETY

Why Did This Leg Fail?

Bullet Hole @ 108’ AGL

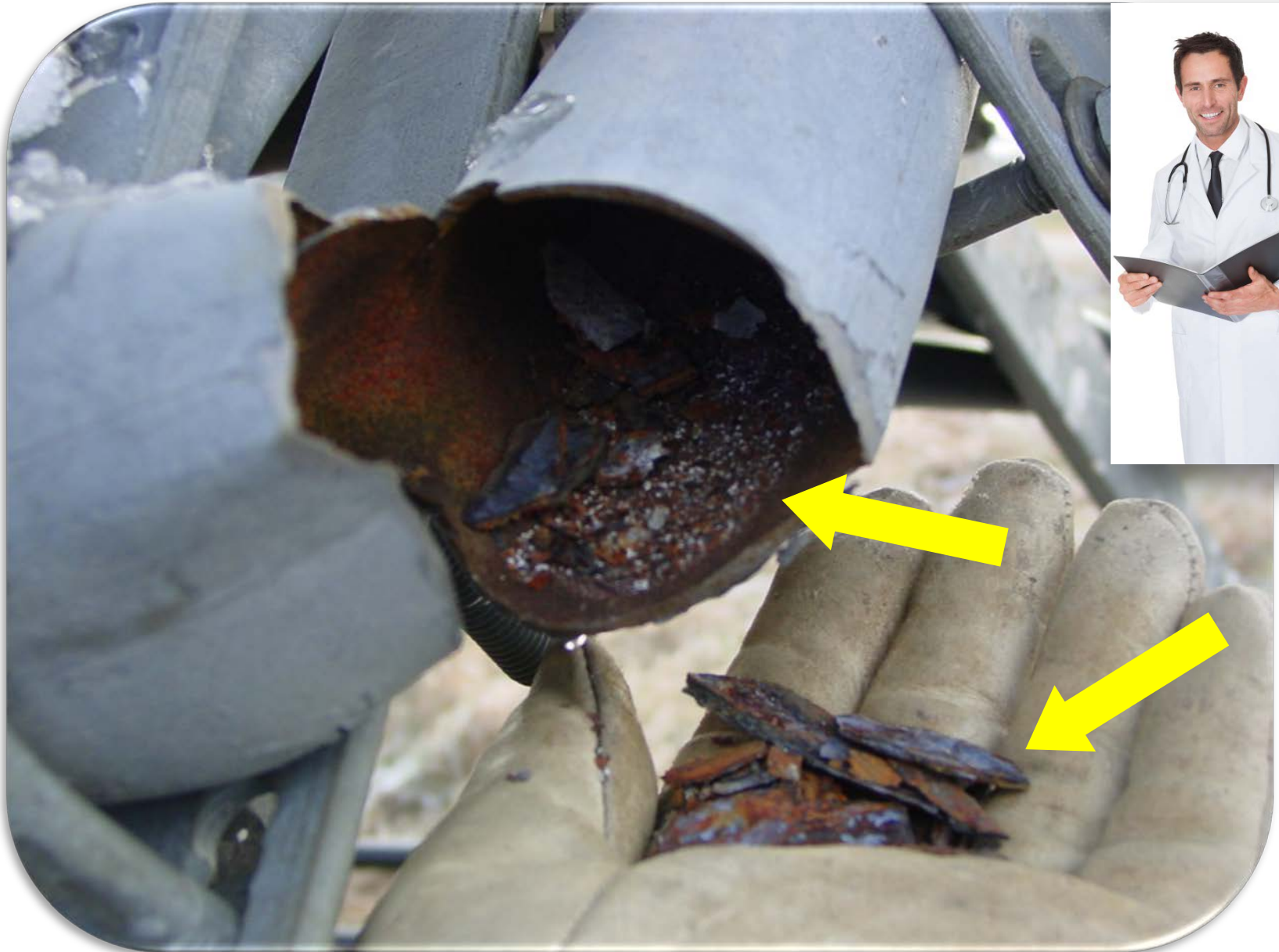
Bigger Bullet Hole @ 250’ AGL

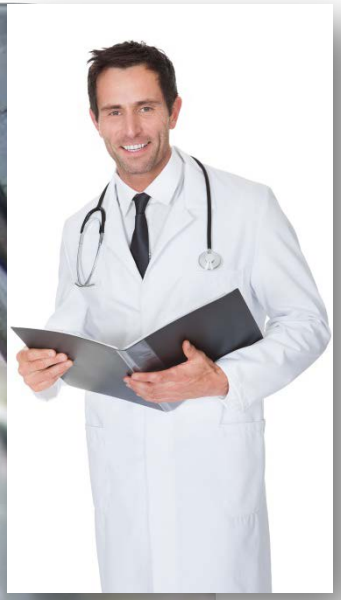
Shooting At Building & Missed

What Can I Say?

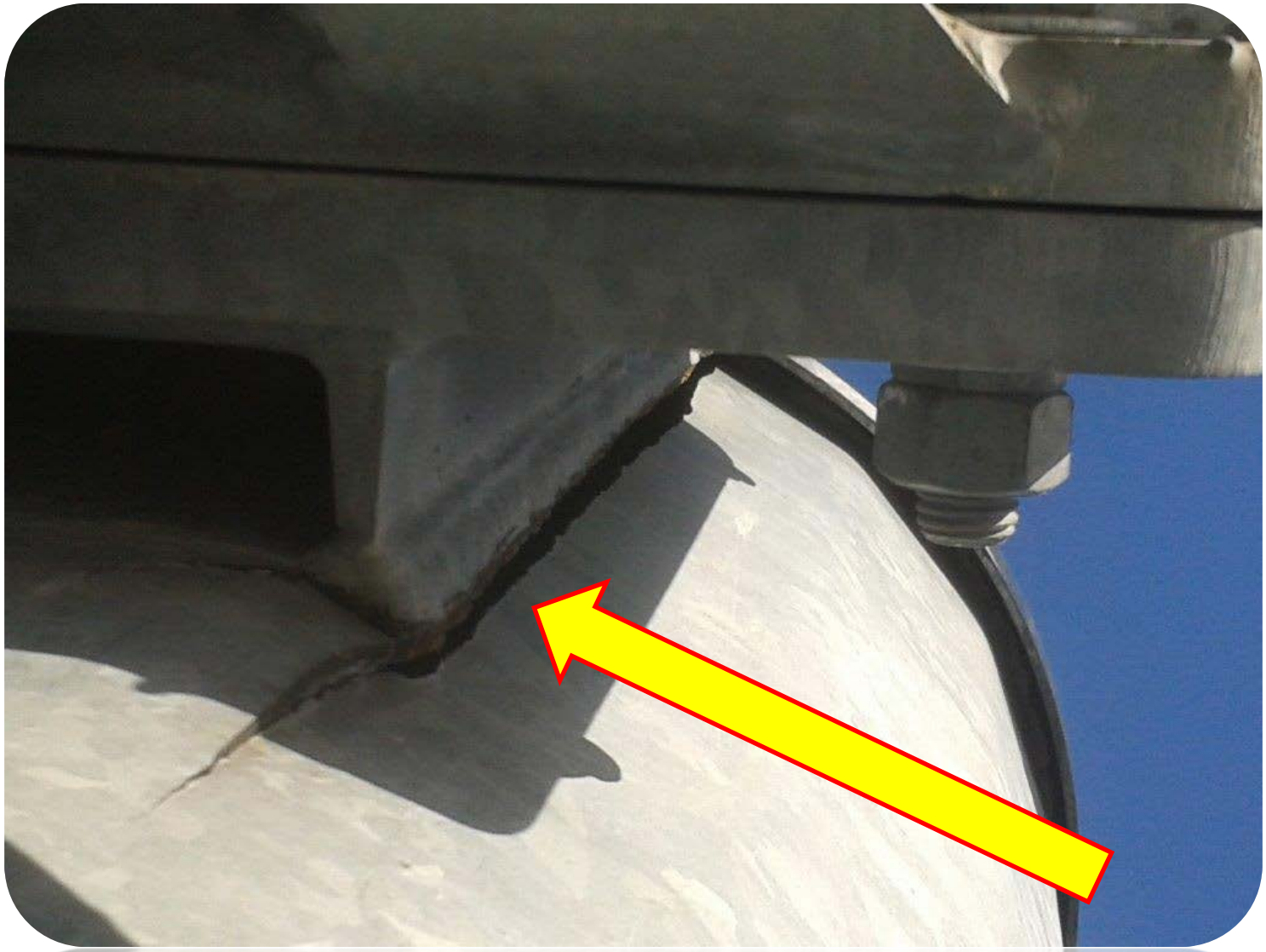
Why Hasn’t This Fallen?

Dying From The Inside Out ….
Well Doc' – It's Terminal Corrosion

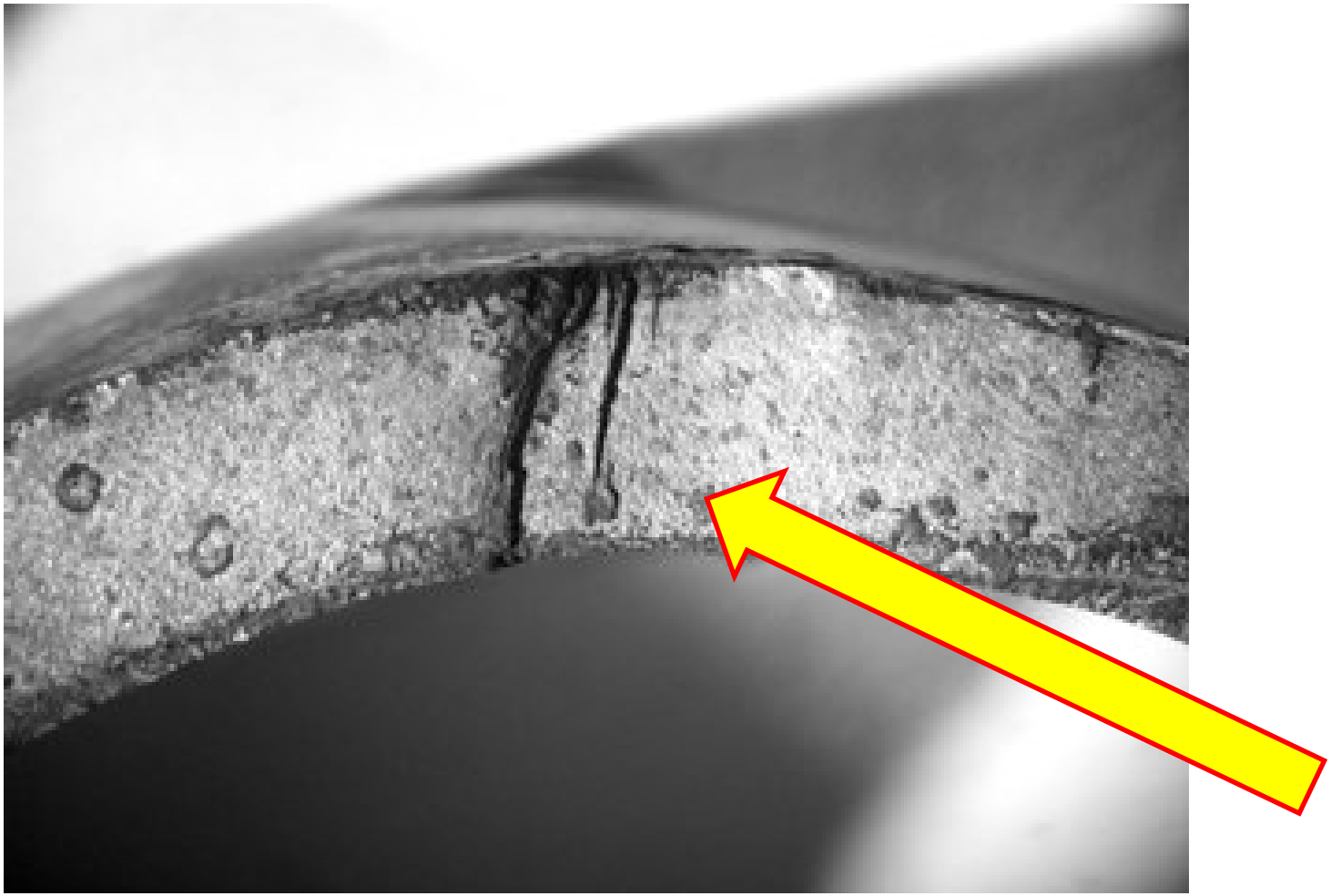




This is a Fatigue Crack
These are Bad ! This is Why You Must Inspect !



This is a Fatigue Crack In Pipe Leg Wall



NDT (non-destructive testing) - Ultrasonic

Types of Wind Induced Vibration

- **Low Frequency / High Amplitude**
  - AKA “Galloping” guy wires
  - Can be dampened out
  - Sometimes ICE induced (airfoils)
- **Galloping and Flutter**
  - These vibration phenomena occur when the motion of a structure generates fluid forces that reinforce the vibration.

Types of Wind Induced Vibration

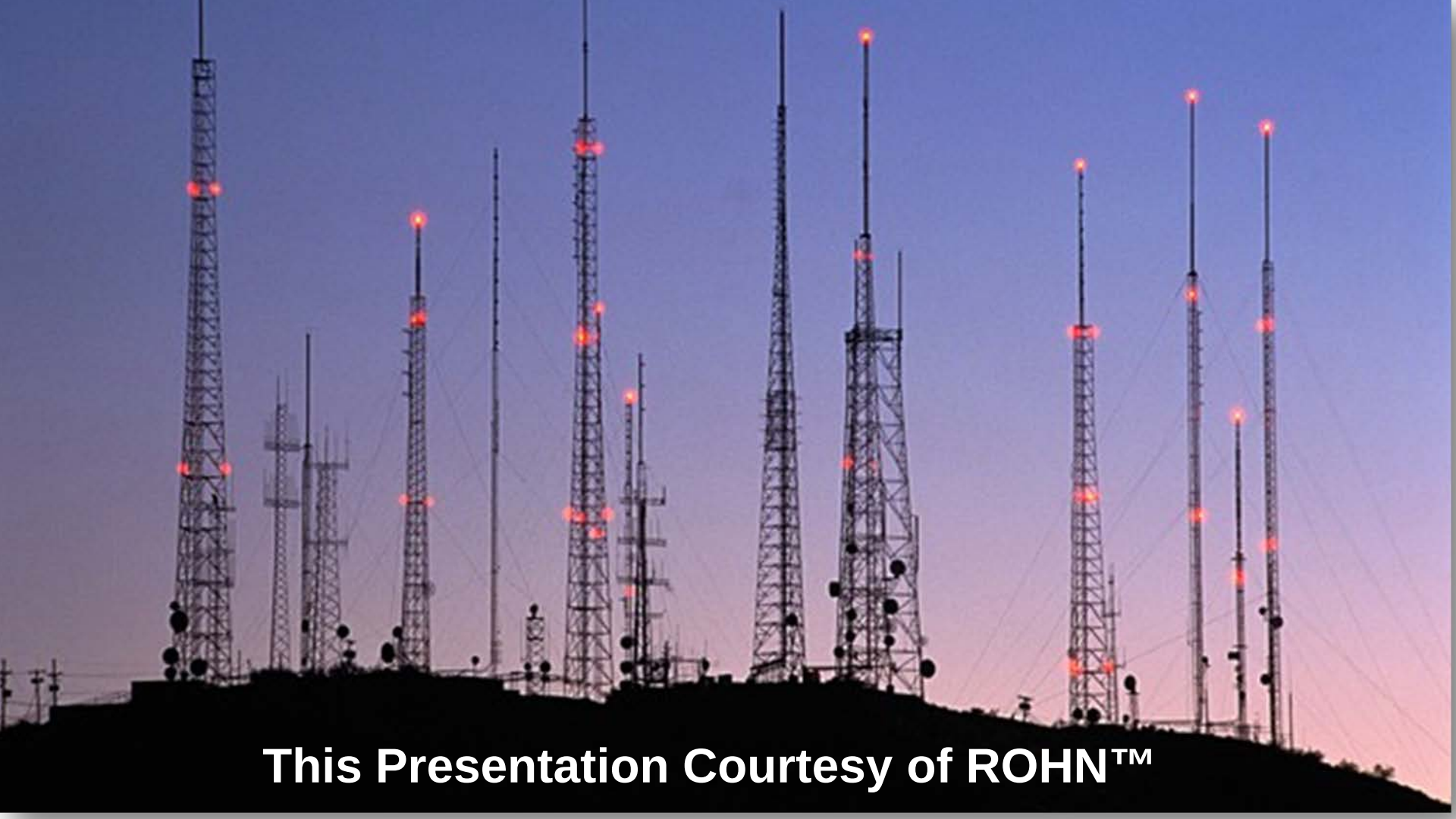
- High Frequency / Low Amplitude
  - AKA “Aeolian”
  - Can be damped using “Stockbridge” dampeners
  - Causes fatigue in guy wire strands
  - Common fail points are at end point connections

Examples of Induced Vibration Fatigue in Guy Wires

– These are BAD things!
– These cables should be replaced immediately!
– Additional fatigue and failure is likely, find cause

Let’s Review -A Few “Known’s”

- A well designed tower has many inherent safety factors built-in.
- No design can save your tower from:
  - Failure due to lack of maintenance
  - Acts of God – i.e. tornadoes
  - Sabotage or Vandals
  - An anchor failure
  - Critical mistakes during erection / modification
  - Unauthorized / non-engineered modifications
  - Accidents – i.e. aircraft strikes



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